2023-24 Winter Outlook

For Northern and Central NM

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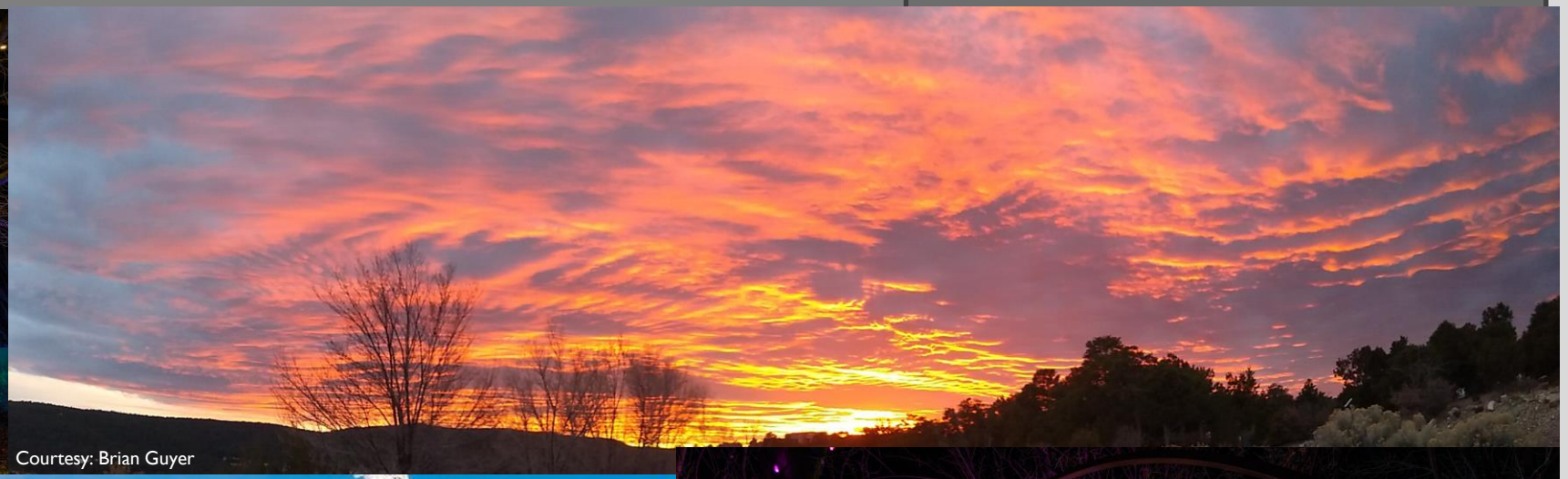
Issued: 10/31/2023

Courtesy: ABQ Biopark


Courtesy: Brian Guyer

Courtesy: Andrew Mangham

Courtesy: Angel Fire Resort

Courtesy: ABQ Biopark

How will a moderate to strong El Niño influence winter precipitation in central and northern NM this upcoming winter season?

2023-24 Winter Outlook

Current ENSO Status

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El Niño Southern Oscillation (ENSO) Status from the Climate Prediction Center (CPC)

ENSO Alert System Status: El Niño Advisory

El Niño conditions are observed.*

Equatorial sea surface temperatures (SSTs) are above average across the central and eastern Pacific Ocean.

The tropical Pacific atmospheric anomalies are consistent with El Niño.

El Niño is anticipated to continue through the Northern Hemisphere spring (with an 80% chance during March-May 2024).*

2023-24 Winter Outlook

Sea Surface Temperature Anomalies or Difference from Average

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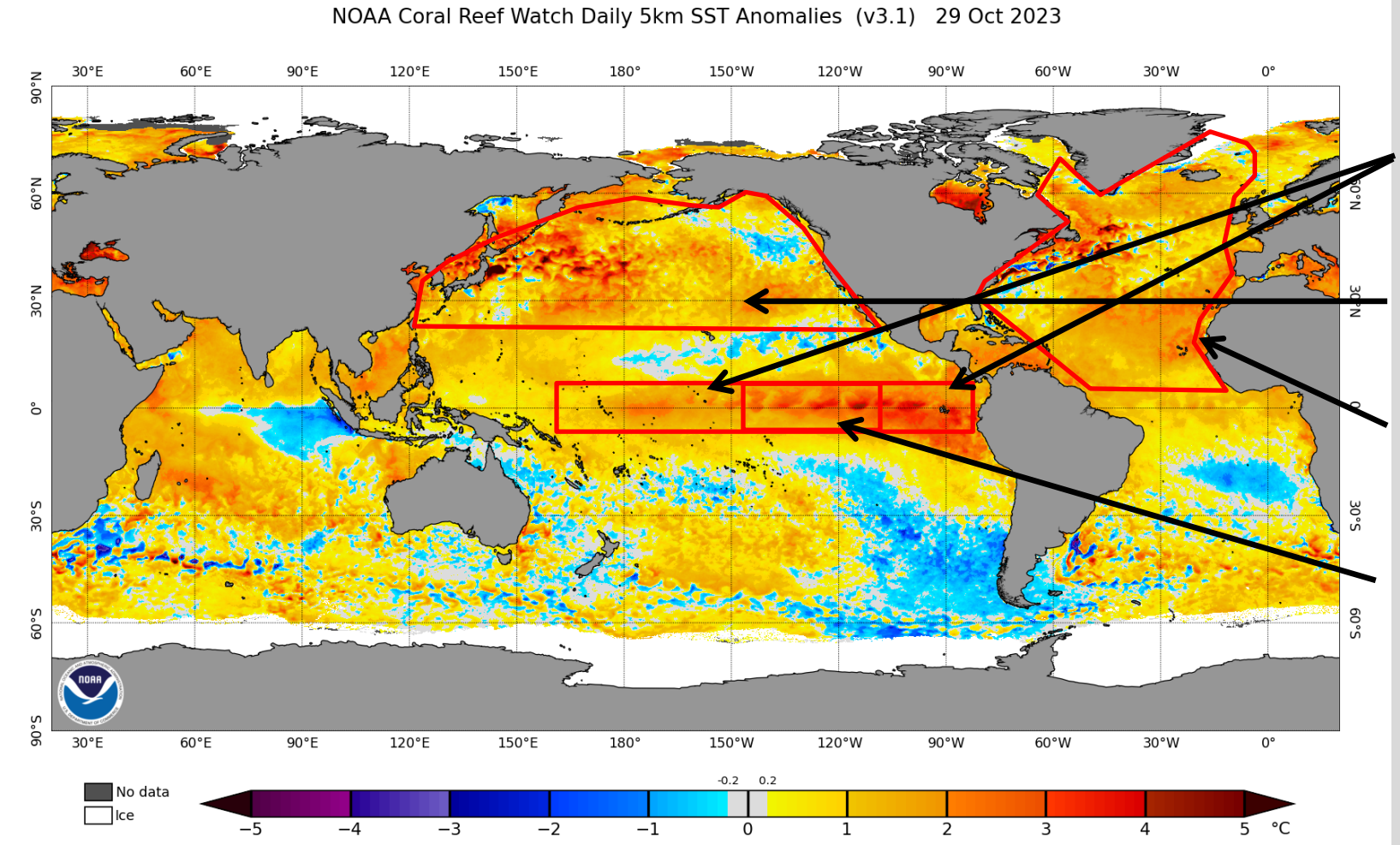

- Multivariate ENSO Index (**MEI**) for AUG-SEP 2023: +**0.6**
- Pacific Decadal Oscillation (**PDO**) for SEP 2023: **-2.11**
- Atlantic Multidecadal Oscillation (**AMO**) for SEP 2023: +**1.41**
- Oceanic Niño Index (**ONI**) (uses Niño 3.4 region - inner rectangle) for JAS 2023: +**1.3** (+**0.5** = El Niño)

Latest weekly global SST anomalies showing an area of much warmer than average temperatures in the eastern equatorial Pacific in El Niño territory (+0.5°C or warmer than average in Niño 3.4 region for 3 month period). Also note the large expanses of well above average SSTs in the northern hemisphere.

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Current SSTs and SSTAs

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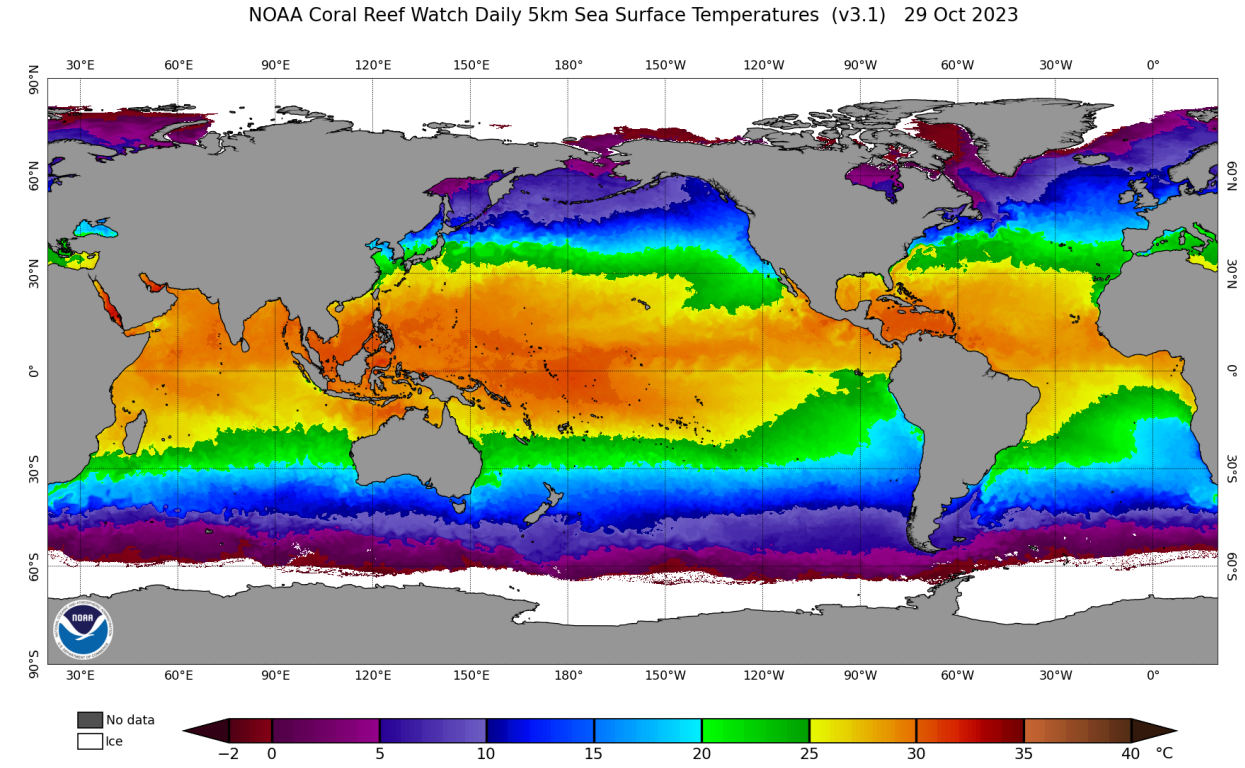

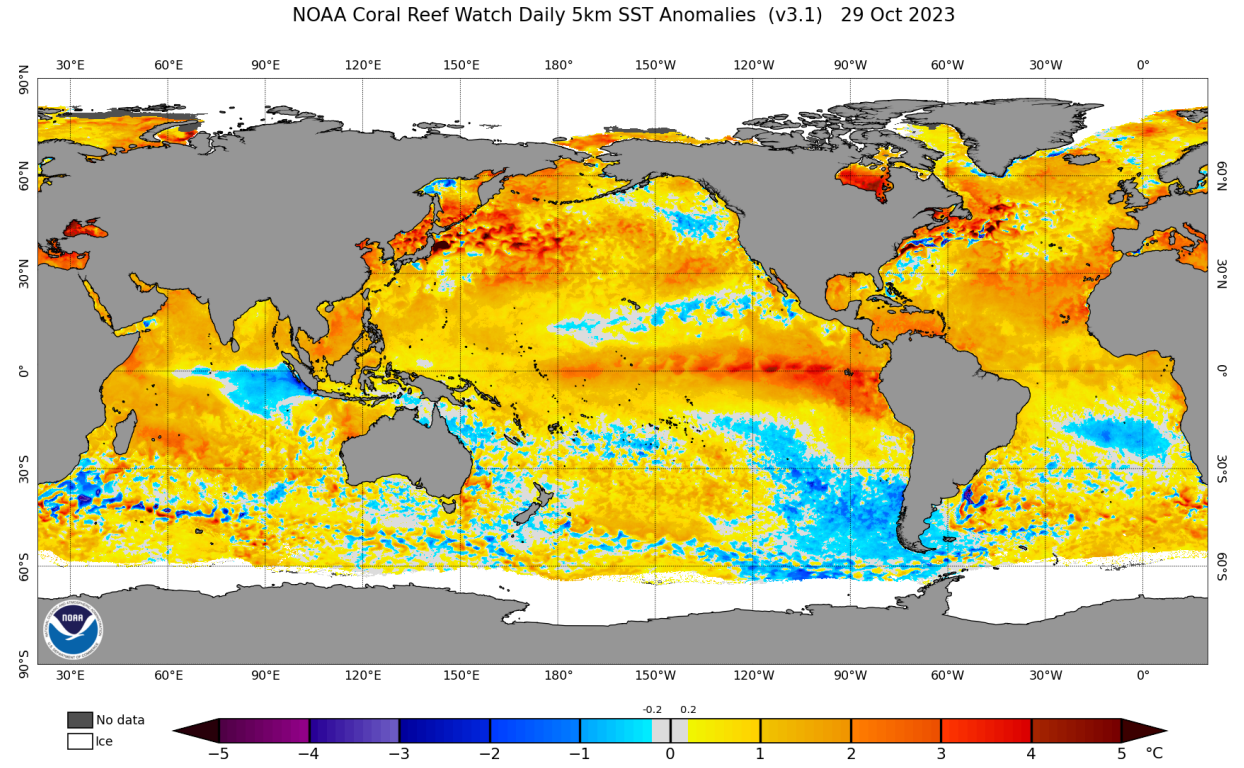

Sea surface temperatures (SSTs) on the left with difference from average SSTAs on right. El Niño is very evident along with other areas of expansive well above average SSTs in the northern hemisphere. Atmospheric Rivers (ARs) are long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. Well above average SSTs in the northwest Pacific associated with a negative Pacific-Decadal Oscillation (PDO) allow for atmospheric rivers to be more prolific and more frequent.

2023-24 Winter Outlook

Pacific Decadal Oscillation (PDO)

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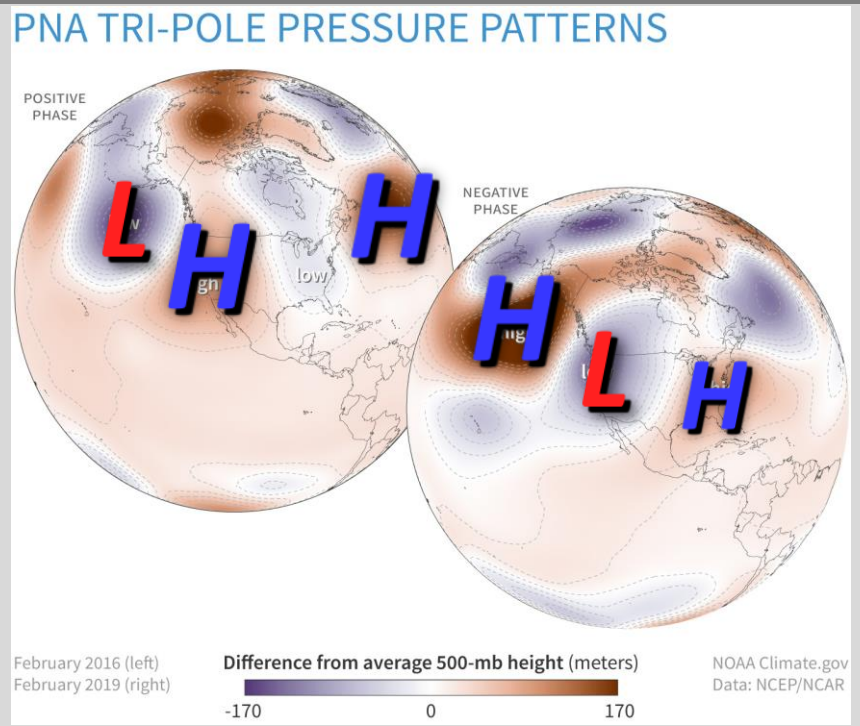

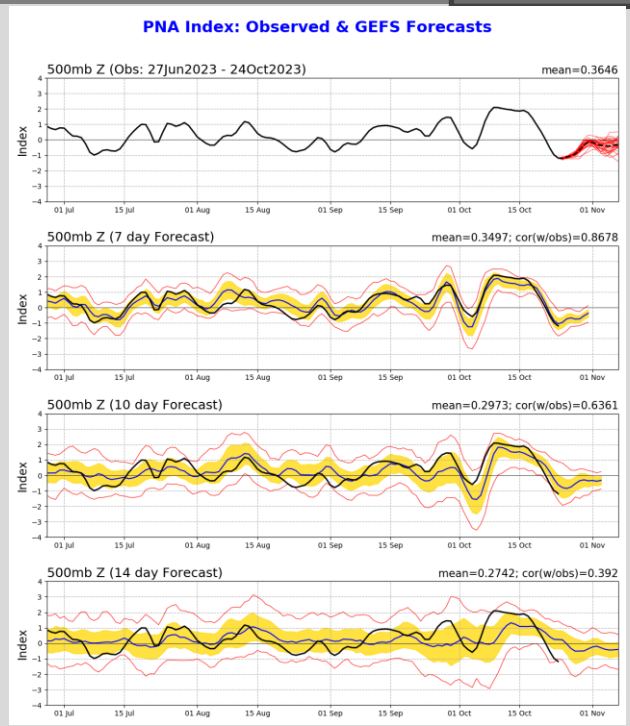

Similar to how a river will flow faster when pinched between two boulders, the atmosphere has similar disruptions due to Earth's geography, the spin of the planet, and differences in solar heating. One such semi-permanent feature is the Asian-Pacific or East Asian jet stream, a fast moving river of air that rips off the coast of Japan and crosses over a large swath of the North Pacific Ocean. This jet stream is a major reason the PNA pattern exists; the PNA prefers to exist near the exit region of this jet—and in fact derives some energy from this jet, especially in the winter (1). In the positive state of the PNA, above-average pressure is found over the subtropical Pacific (close to Hawaii) and centered over western Canada. Below-average pressure occurs over the North Pacific Ocean and along the southeastern United States. The negative state of the PNA results in the same pattern except with opposite anomalies (regions that have above-average pressure become below-average and vice versa). These changes to the atmospheric circulation influence surface climate conditions. During the positive PNA, a big anomalous ridge of high pressure over Canada results in fewer cold air outbreaks over Alaska, Canada, and the northern tier of the United States (the opposite is true for negative PNA). Texas, the Southeast United States, and most of the East Coast trend colder thanks to the anomalous trough of low pressure over this region. The PNA is considered the second "leading" pattern of the Northern Hemisphere, with the Arctic Oscillation or North Atlantic Oscillation in first place because it describes slightly more of the atmospheric variations across the hemisphere. (Luann Duhlman - Climate.gov).

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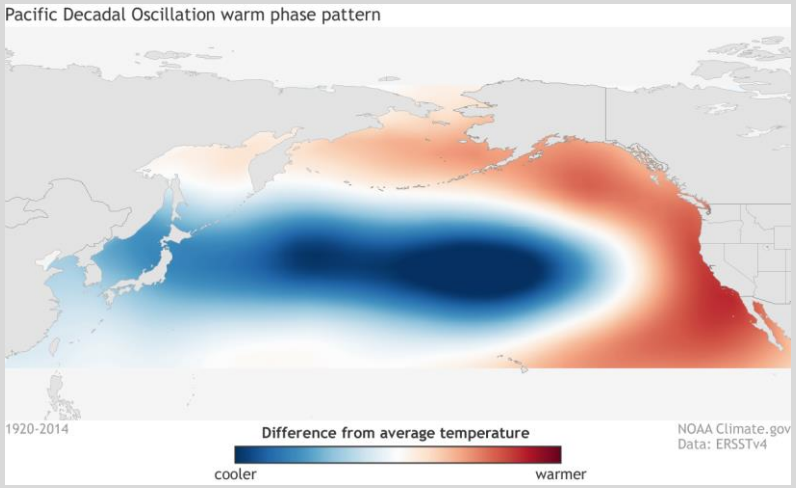
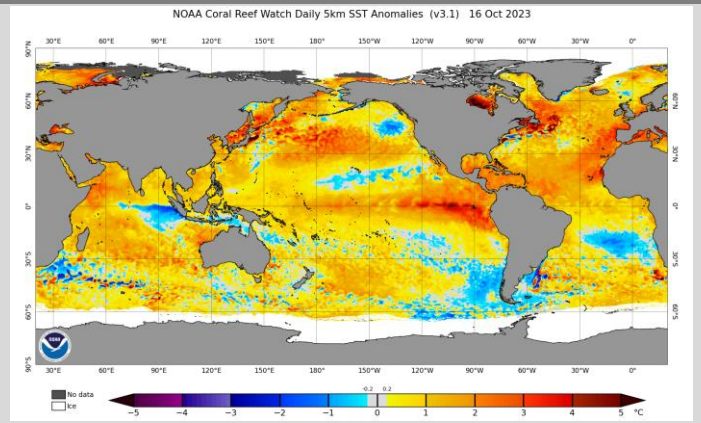
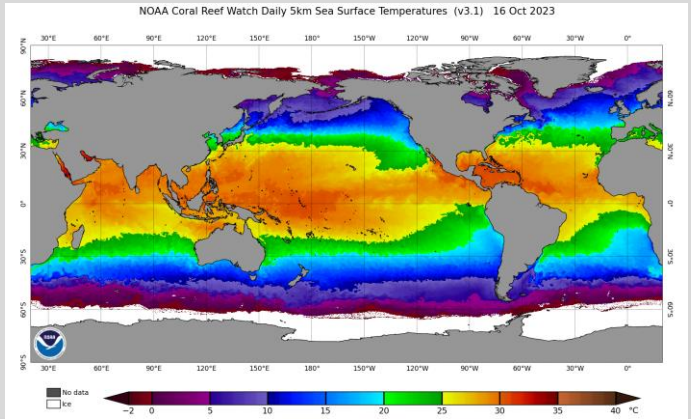
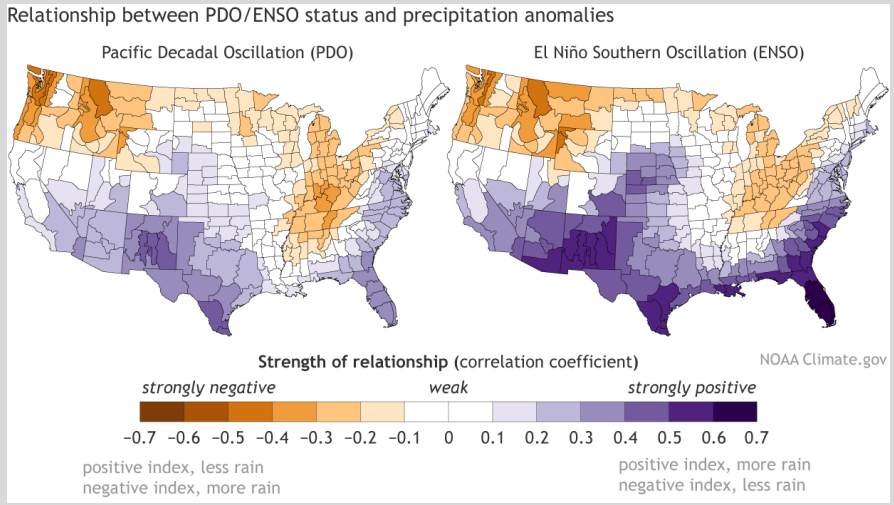
PDO's Influence on NM









PDO Aug, Sep, Oct 2023	PDO Aug, Sep, Oct 2018	PDO Aug, Sep, Oct 2015
-1.68, -1.71, ??	0.03, -0.08, -0.41	1.34, 1.35, 1.08

Typical Sea Surface Temperature Anomaly (SSTA) patterns in the North Pacific Ocean during a positive Pacific Decadal Oscillation phase (PDO). As with ENSO, a positive PDO correlates well with above average winter precipitation in the southwest United States. A negative phase of the PDO in 2023 would have normally reduced the strength of the relationship, but there are signs that may be changing. Why? The El Niño of 2018 showed that a strong and long-lived SST gradient near the Marshall Islands in the CPAC can act at times to create a negative Pacific North American (PNA) pattern or a pattern at times similar to a negative PDO.

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Comparing This Year With Recent El Niño Climate Patterns' SSTAs

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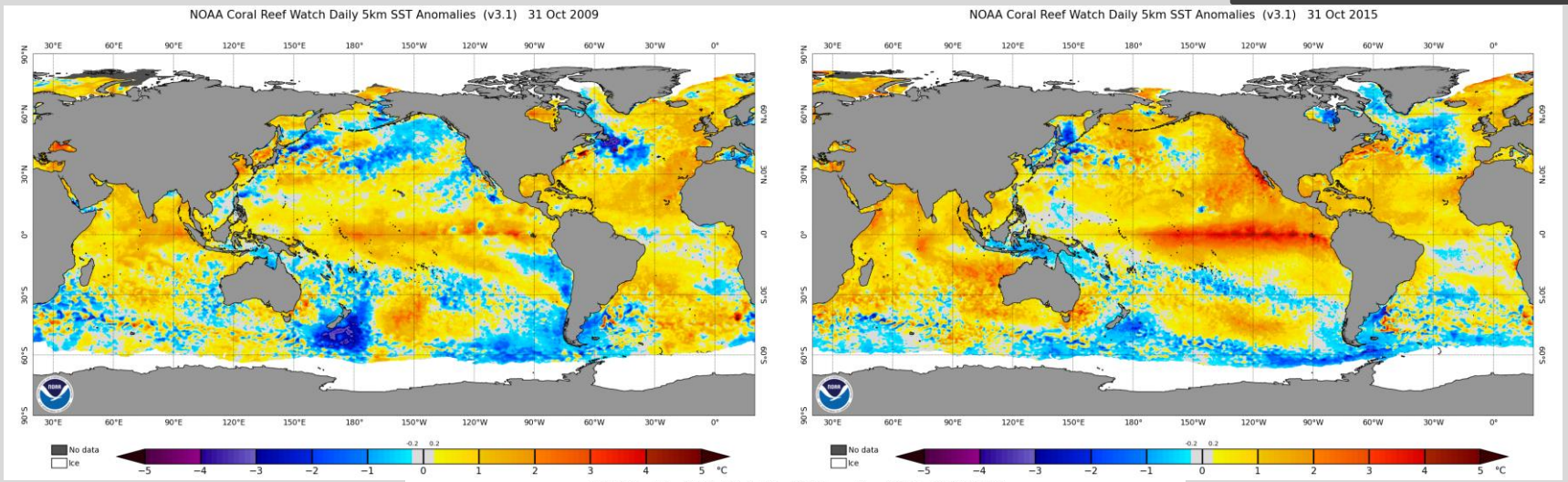

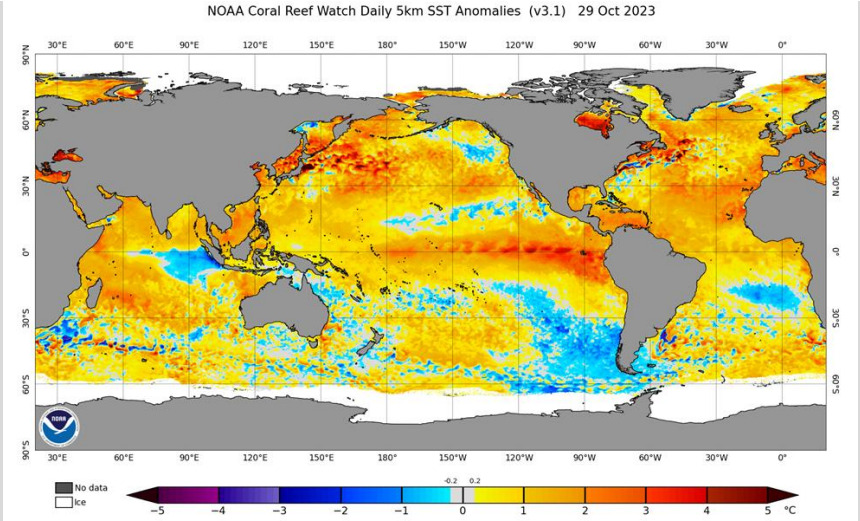

Comparing this year's El Niño to recent moderate to strong events. SST gradients or difference from average are notably dissimilar when comparing 2023 to the 2015-16 event. What does it mean? All El Niño climate events are different from one another. A negative PDO (warm water in the northwest PAC with relatively cool waters along the west coast of North America) is what separates this year compared to the strong El Niño of 2015-16. This year is looking more like the moderate El Niño of 2009-10 due to the negative phase of the PDO.

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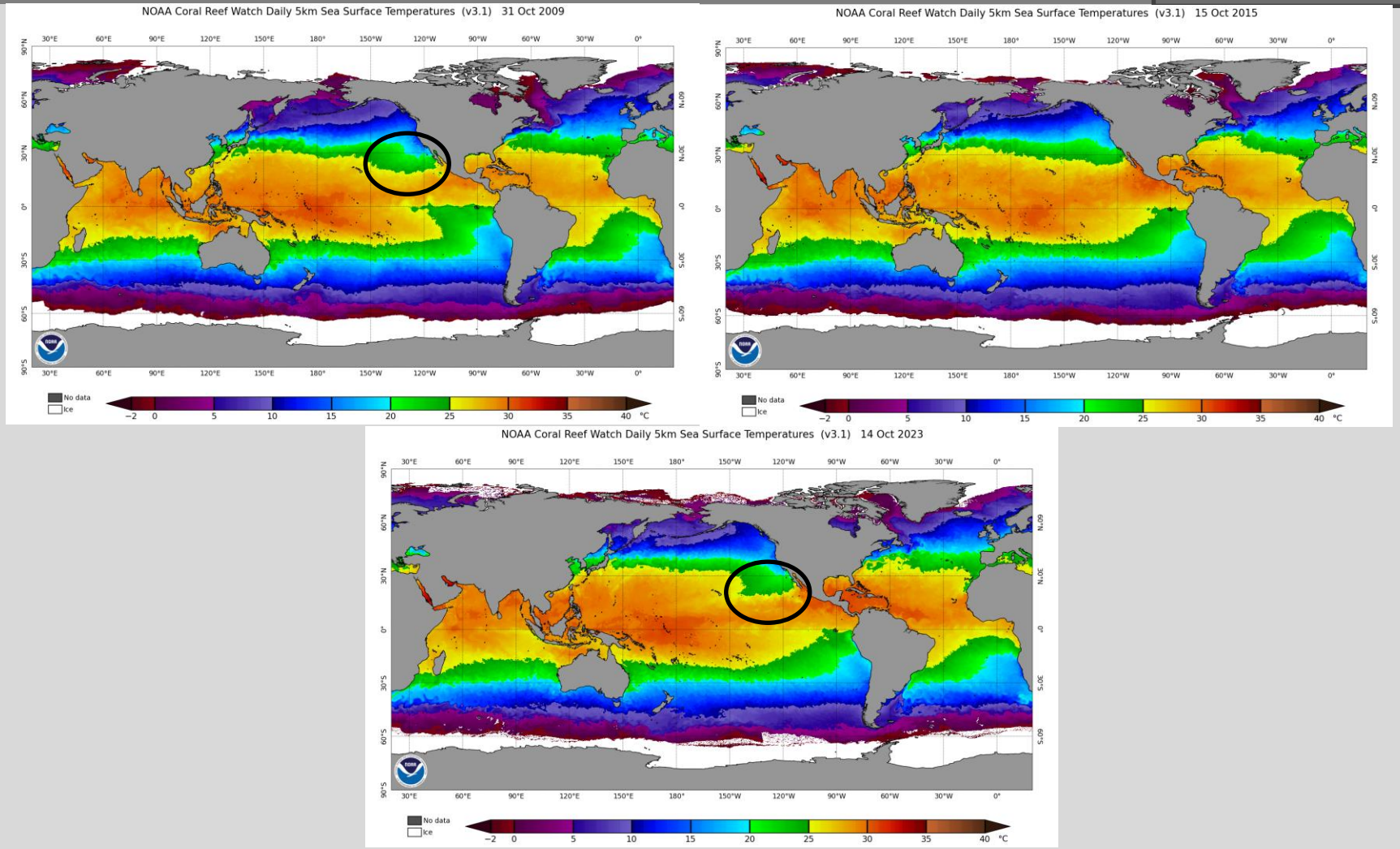
SST Gradients



ENSO prediction, after all, is all about the SST gradients. While warm water is necessary for thunderstorms to develop, surface convergence can be key to where deep convection in the tropics and subtropics develops most commonly during the upcoming winter season. Where does the 2023 SST gradient set up in the EPAC? 2023 is showing signals that are closer to 2009 than 2015 thanks to a negative or cool phase of the PDO.

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How El Niño Influences the Asian-Pacific Jet

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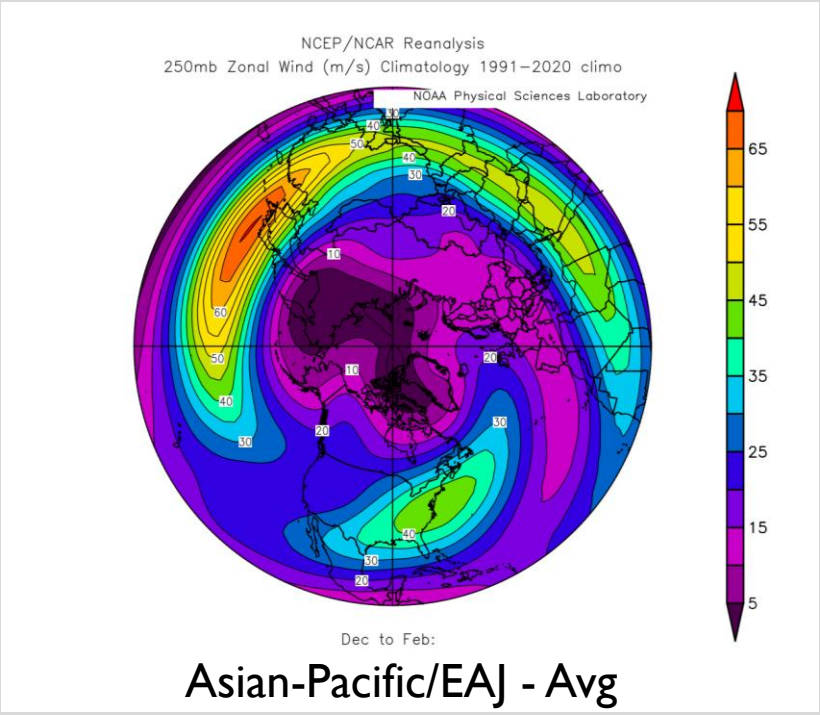
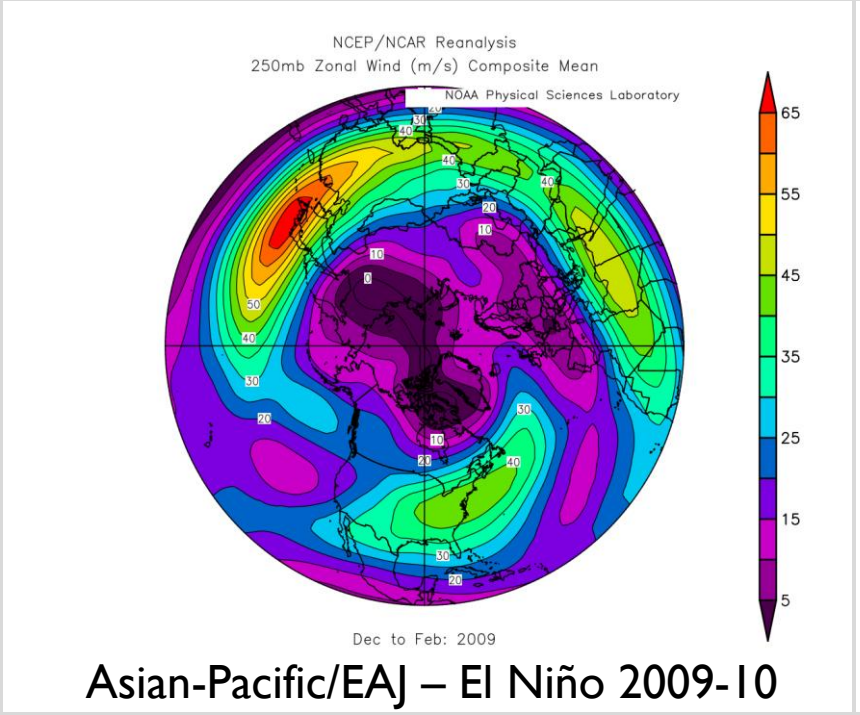
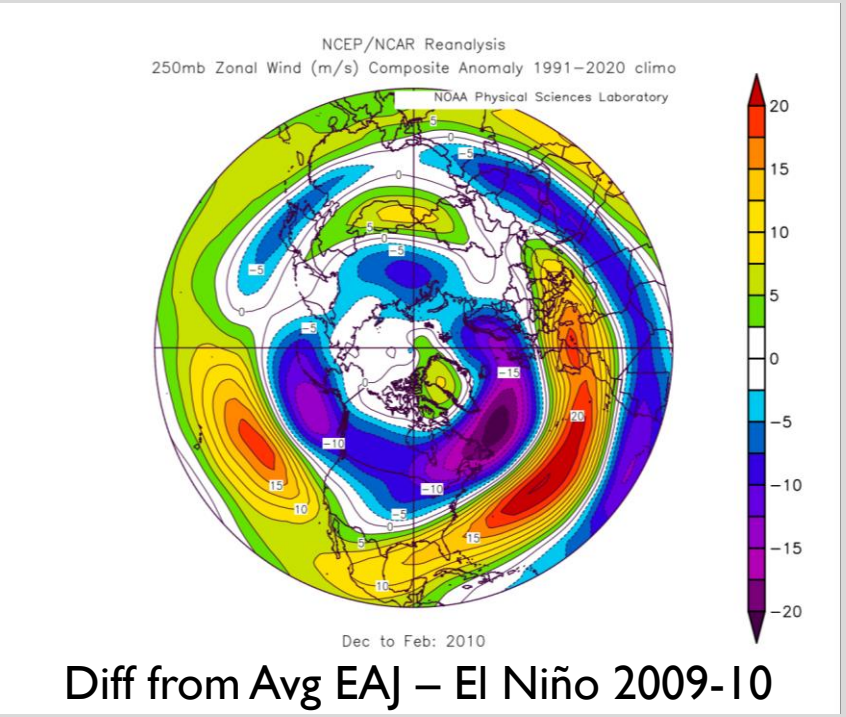


Asian-Pacific/EAJ - Avg



Asian-Pacific/EAJ – El Niño 2009-10



Diff from Avg EAJ – El Niño 2009-10

All this talk of how thunderstorms in the tropics and subtropics act on the storm track or jet stream, but what is it really we are talking about? This. The above images show a typical wintertime Pacific-Asian or East Asian Jet stream on the left and how the 2009-10 El Niño climate pattern changed the status quo (middle). The typical wintertime jet on the left peaks near 70 m/s or 157 mph just off the coast of Japan and gets much weaker as it translates eastward into the Pacific Ocean. During El Niño, the Pacific and Atlantic jets are enhanced. Why? More thunderstorm activity farther eastward creates this enhanced Northern Hemisphere circulation and weather/climate patterns are temporarily changed. A relatively subtle change is observed when it's averaged out over three months, but the overall concept hopefully makes some meteorological and climatological sense.

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How El Niño Influences Snowfall in North America

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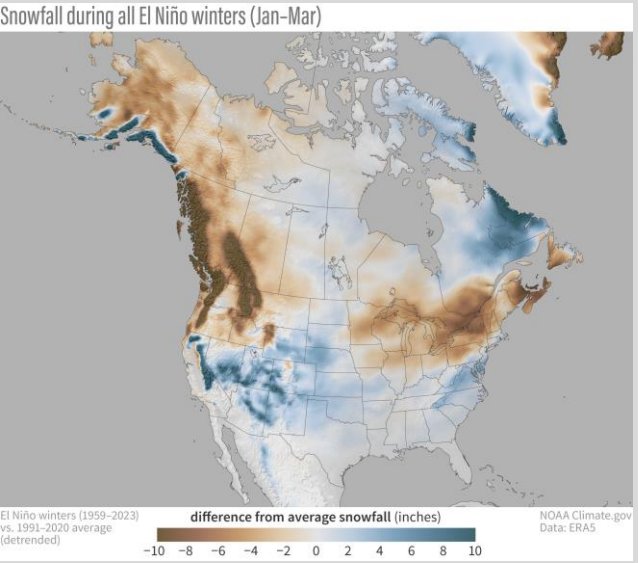

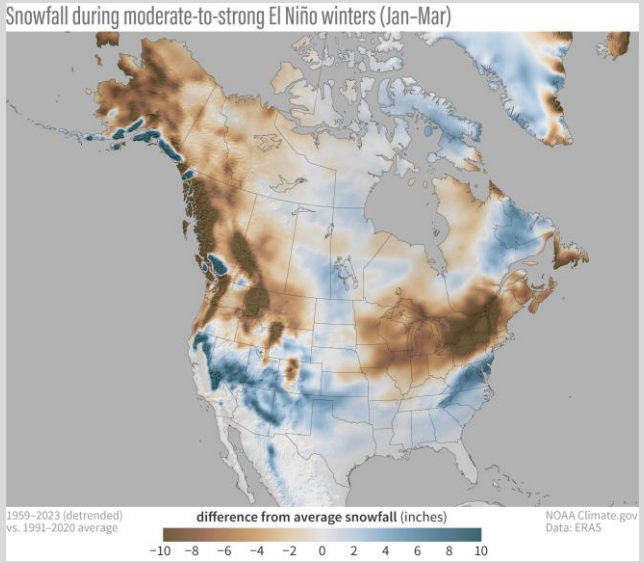

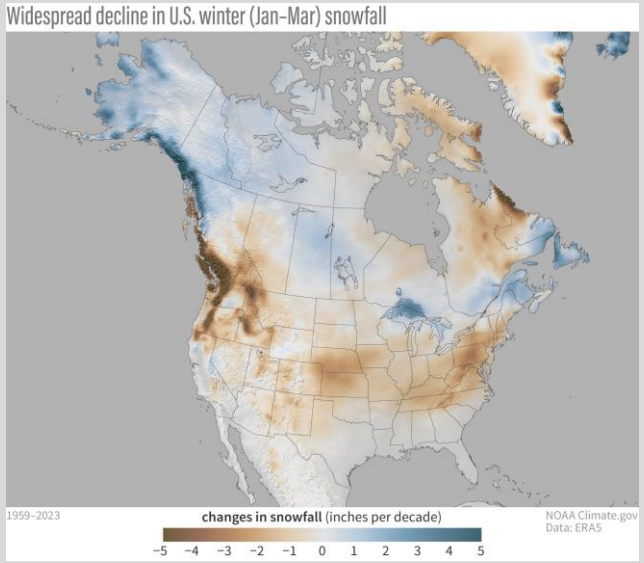

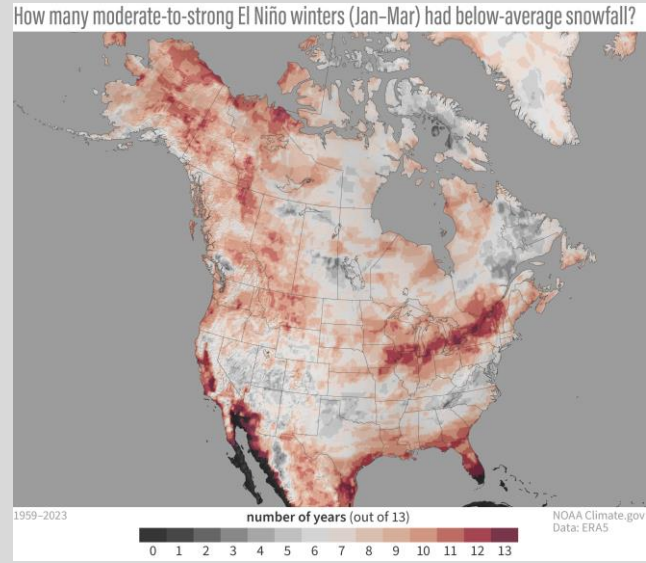

Various snowfall graphics relating to the El Niño climate pattern from January through March. Note the moderate to strong El Niño influences on the top right. Storm track dips farther south compared to weaker events, and the Central Rockies lose out. Also note the overall snowfall decline over much of the lower 48 states. Courtesy: Climate.gov

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How El Niño Influences Precipitation in Different Climate Regions of NM since 1950

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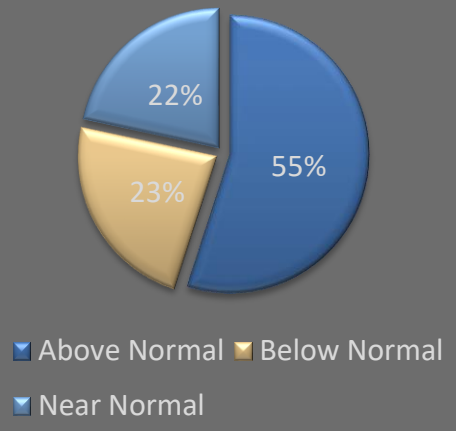
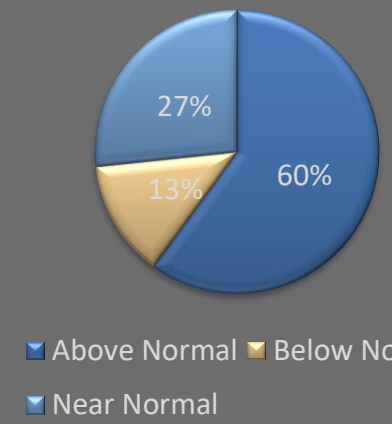
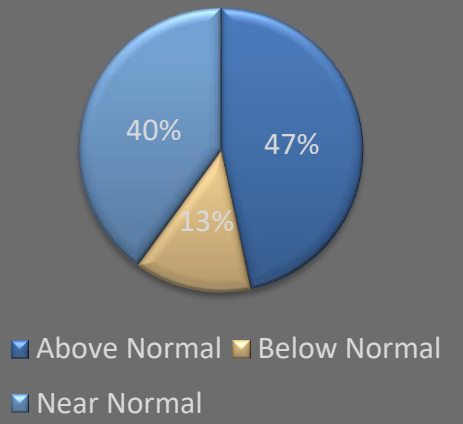
New Mexico



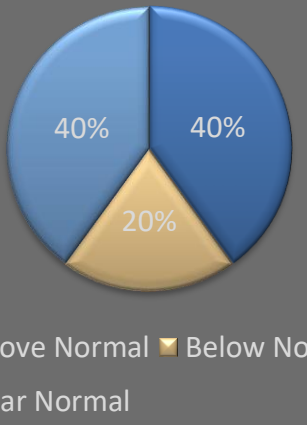
Northwest Plateau



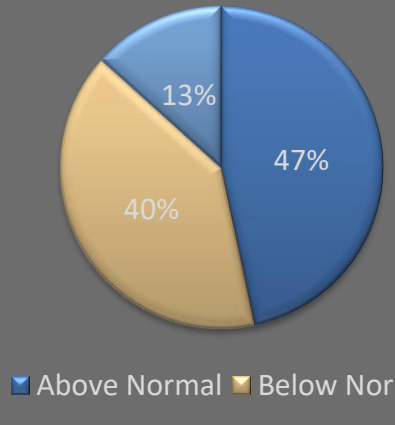
Central Highlands



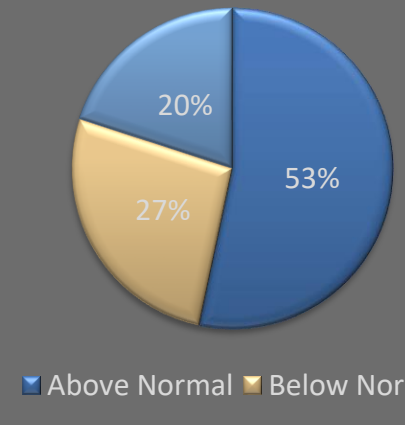
Northern Mountains



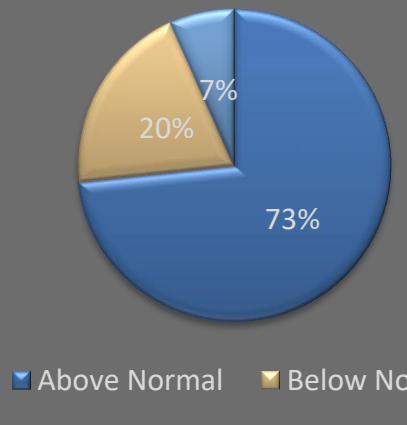
Northeast Plains



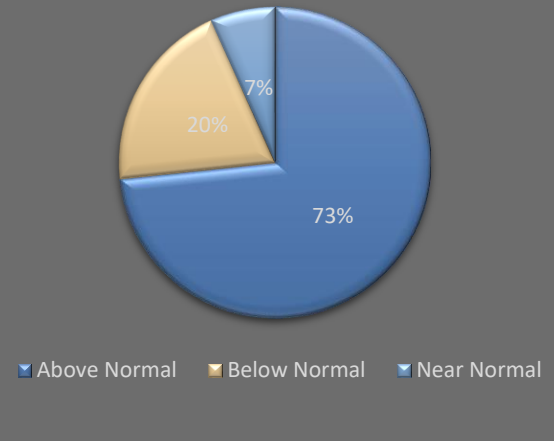
Rio Grande Valley



Southern Desert



Southwest Mountains



Precipitation difference from average in NM's climate divisions during moderate to strong El Niño climate patterns since 1950. Southern and western portions of the state benefit the most from El Niño. Could that, however, be changing?

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Subsurface Pacific Ocean Temperatures

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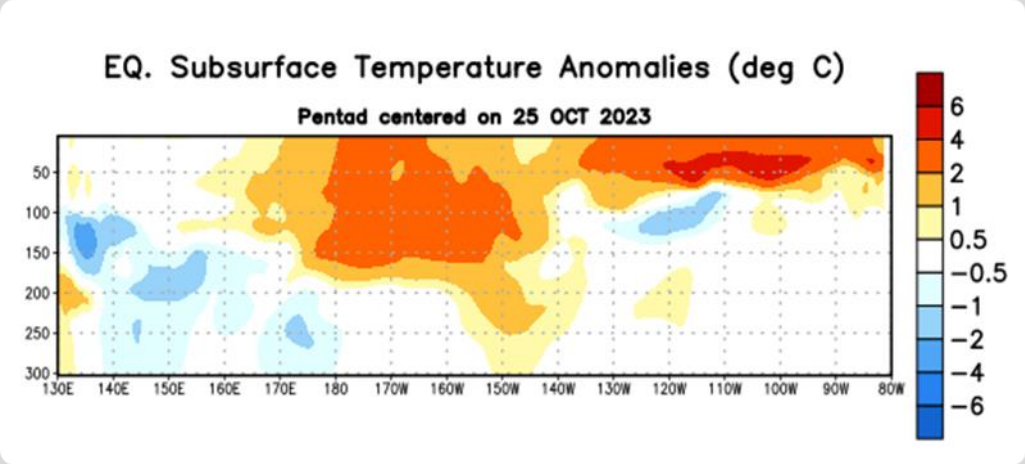

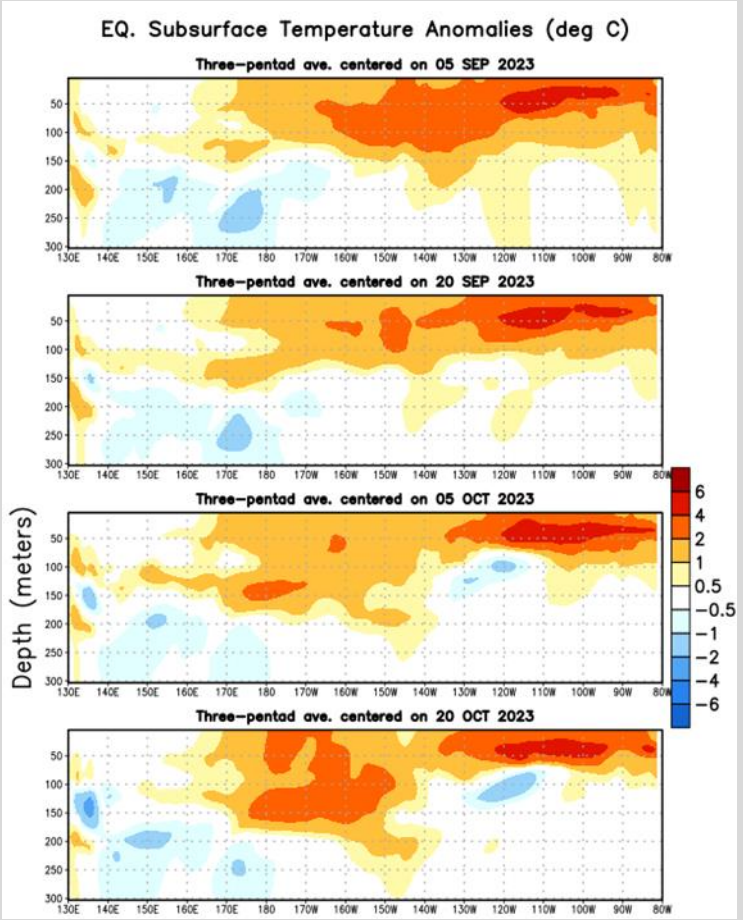

Positive subsurface temperature anomalies weakened around 140°W-110°W, with negative anomalies emerging at depth (50-150m).

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Previous Moderate to Strong El Niño Climate Pattern

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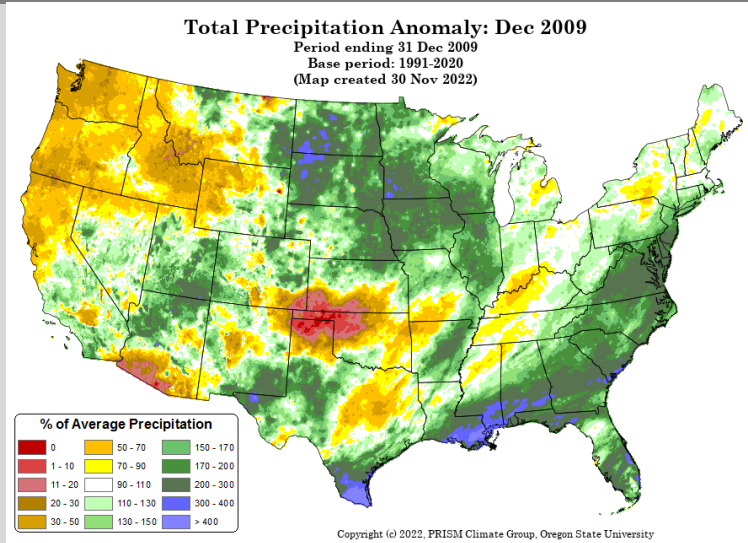

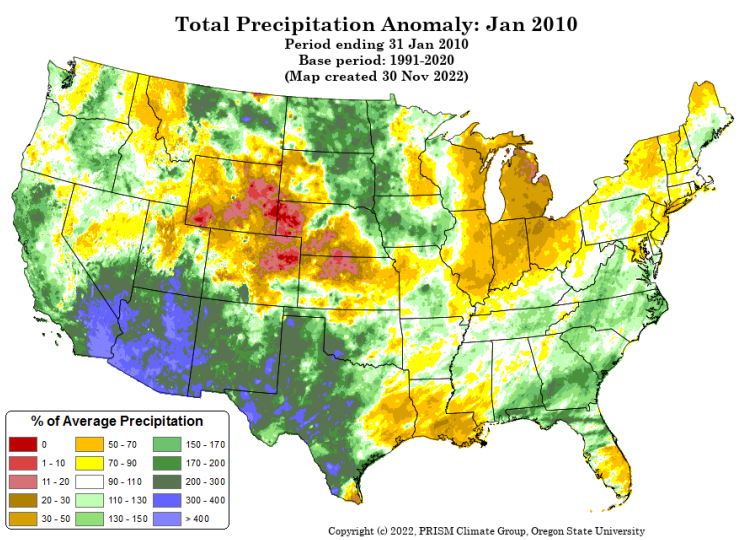

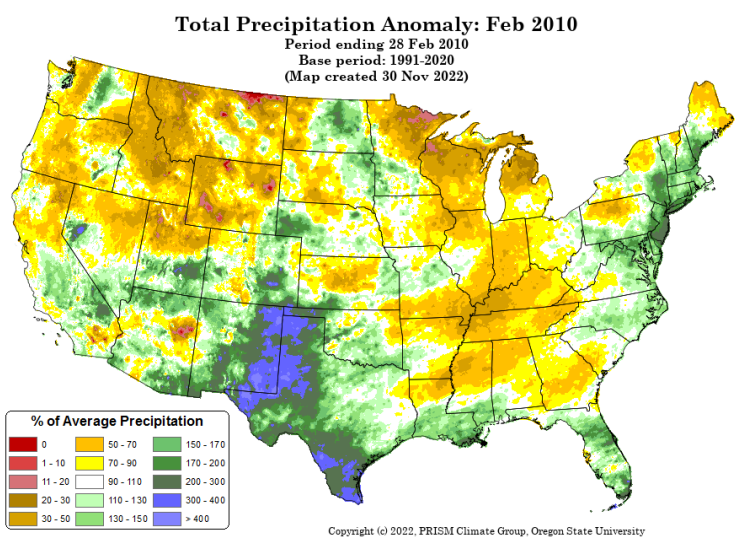

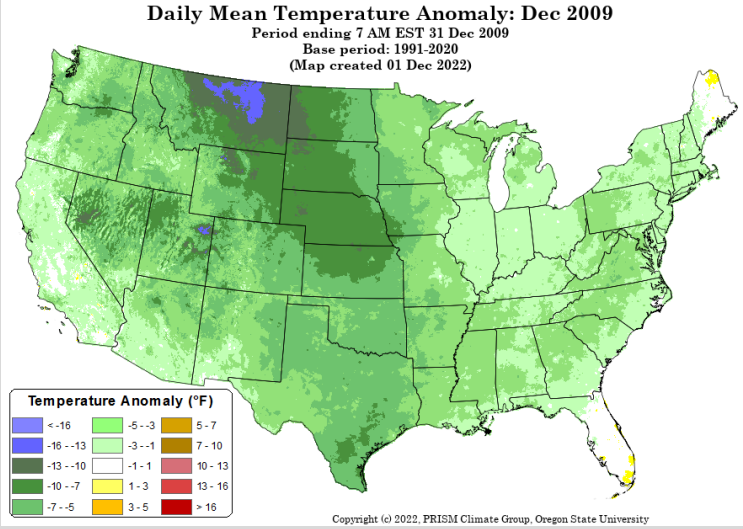

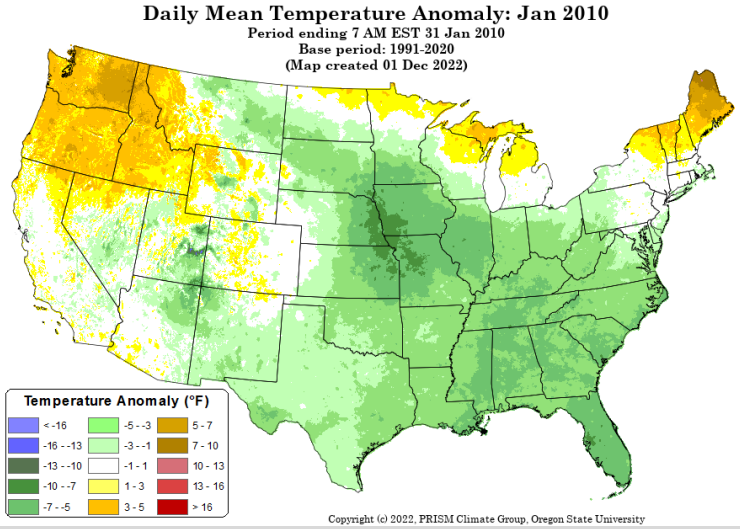

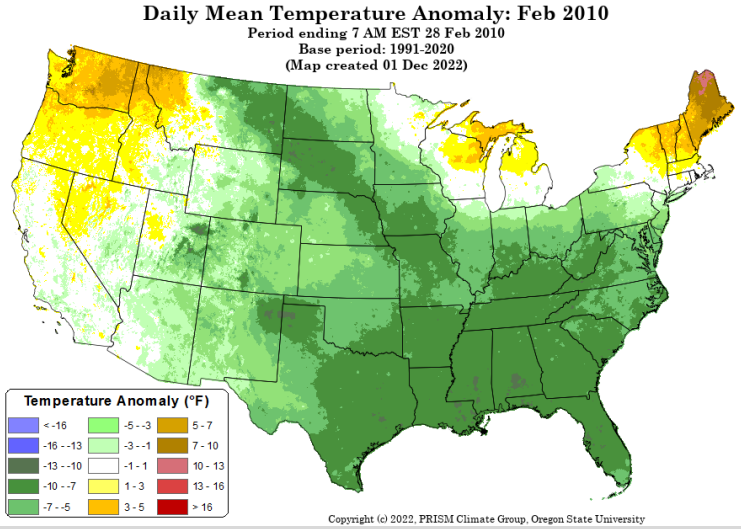

What were precipitation and temperatures like in winter during the last moderate to strong El Niño in 2009-10? The entire state measured above average precipitation and below average temperatures.

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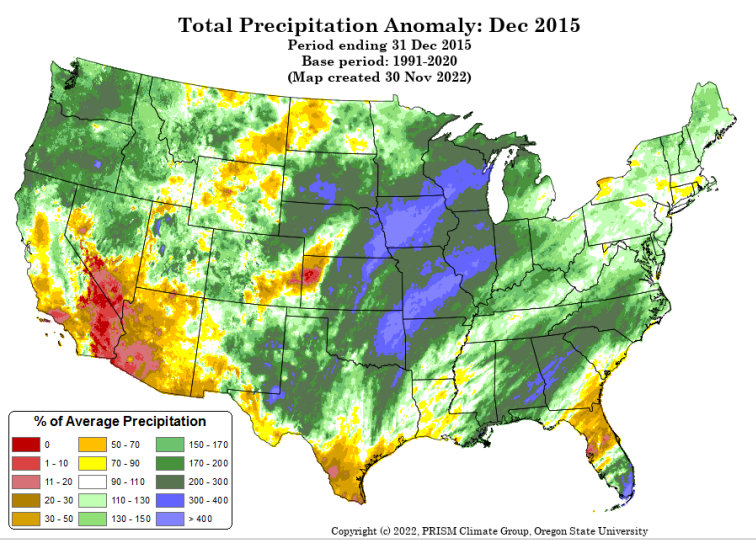
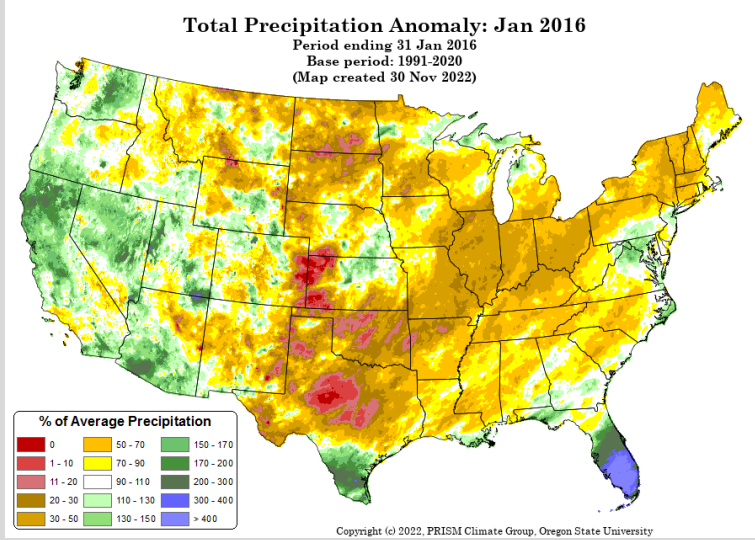
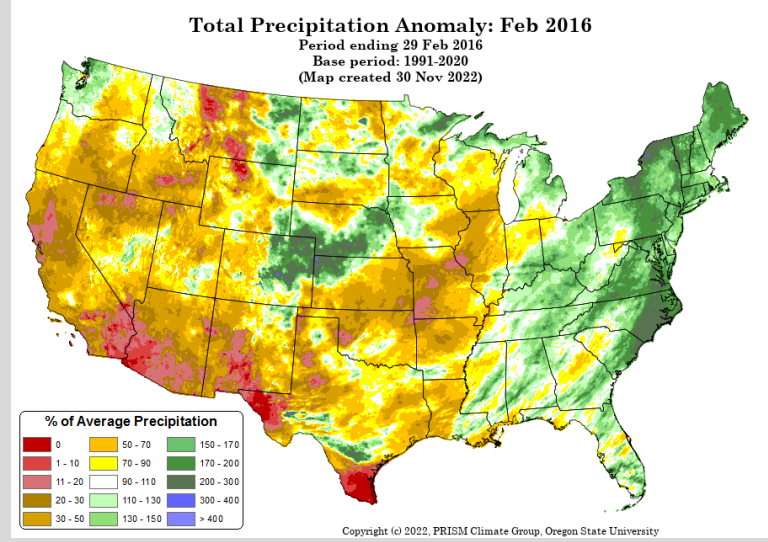
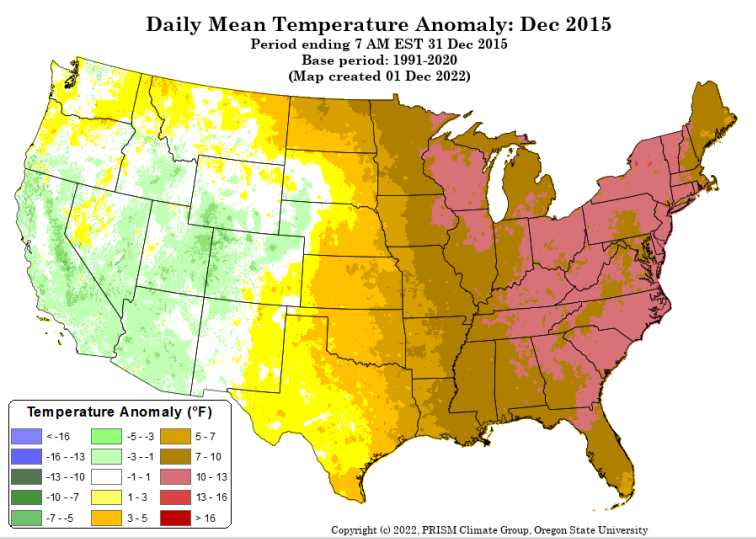
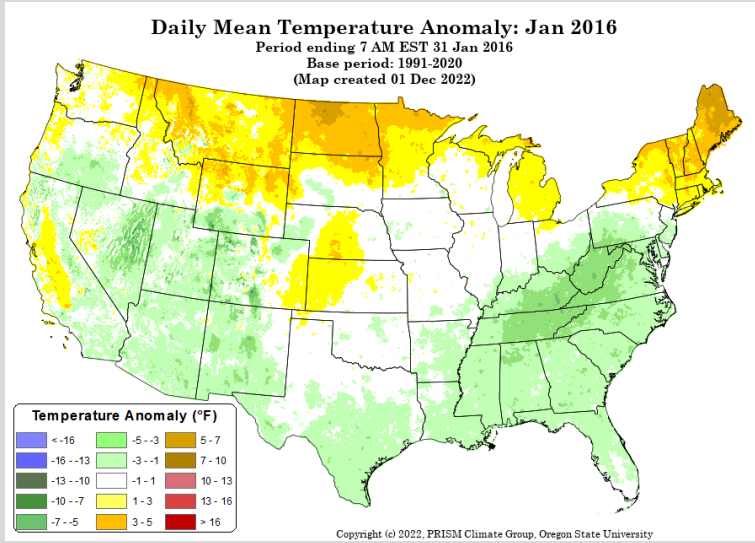
Most Recent Analog Year

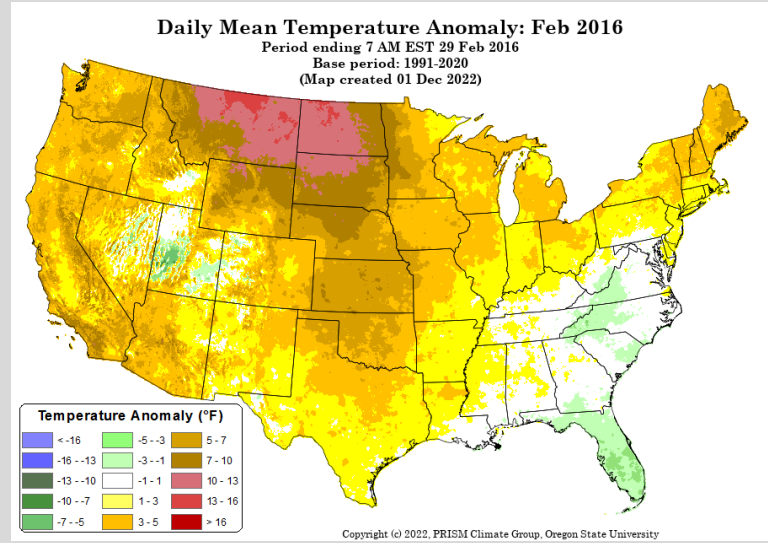












What was winter like during the last strong El Niño in winter 2015-16? One major winter storm in late December 2015 was able to keep winter precipitation near average, otherwise, the storm track went too far south for much of winter. This El Niño is looking different than the 2015-16 event in large part due to a negative or cool phase of the PDO.

2023-24 Winter Outlook

An Easier Forecast This Year?

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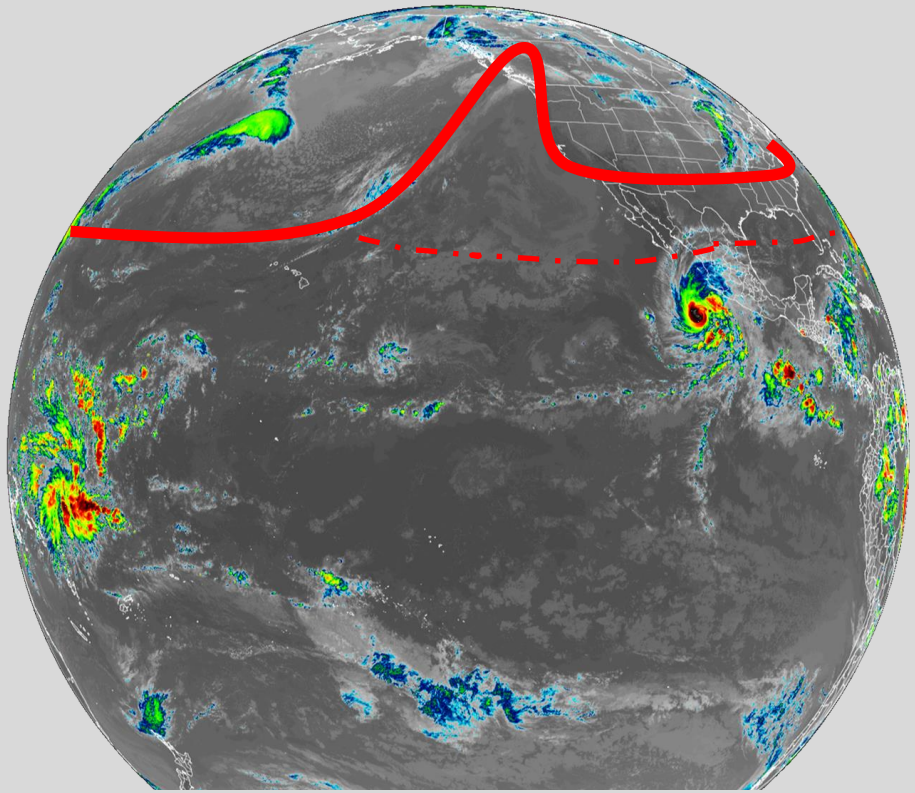
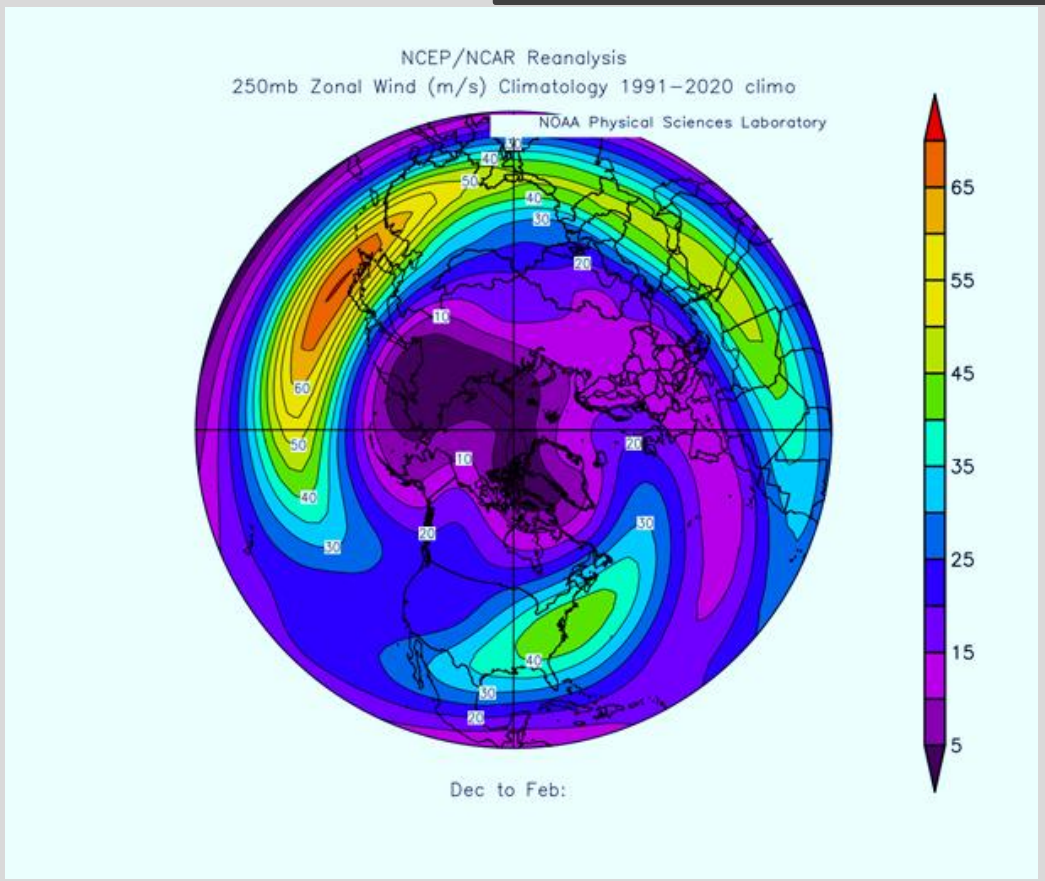


An absence of thunderstorms in the equatorial EPAC forces the polar jet stream (red line) to split in two (subtropical jet = dashed line) and a high amplitude ridge of high pressure develops over the eastern Pacific.



Why might this El Niño be easier to forecast than the 2015-16 event? When a strong Pacific-Asian or East Asian Jet (EAJ), born on a strong temperature difference between the poles and equatorial WPAC, runs into a lack of thunderstorm activity in the equatorial EPAC where the temperature difference is much less, it must split in two to get back into thermal balance. As a result, an upper-level ridge of high pressure builds downwind and so on and so forth. For example, the above satellite image shows the lack of thunderstorms in much of the EPAC. If SST anomalies hold as they did in 2009-10 and 2018, this is the weather pattern that could end up being rather common during DJF 2023-24.

2023-24 Winter Outlook

A Closer Look at SSTs

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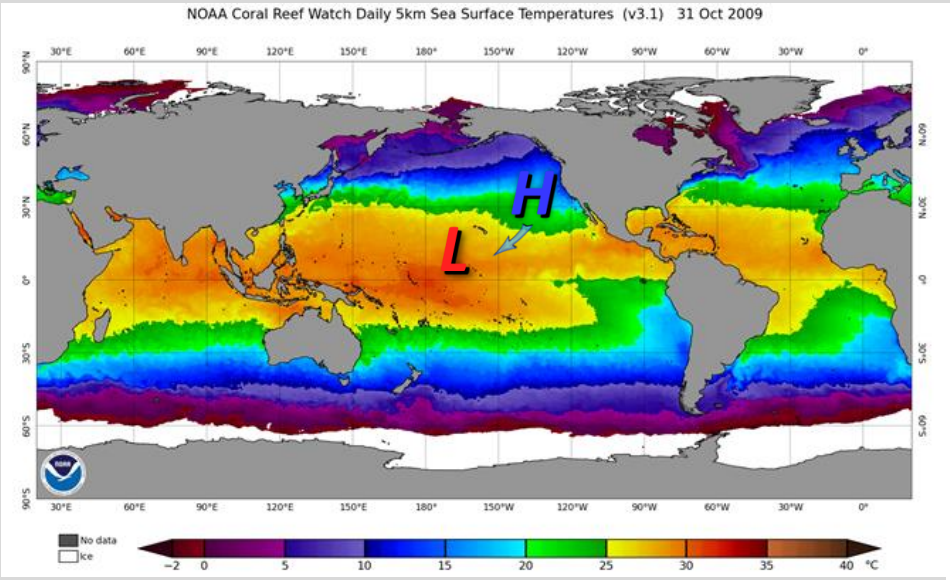

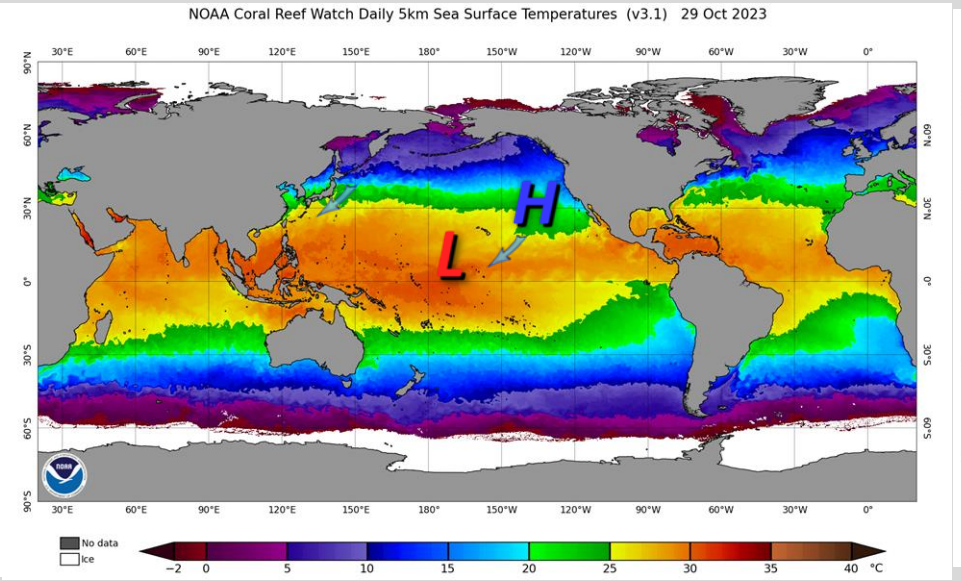

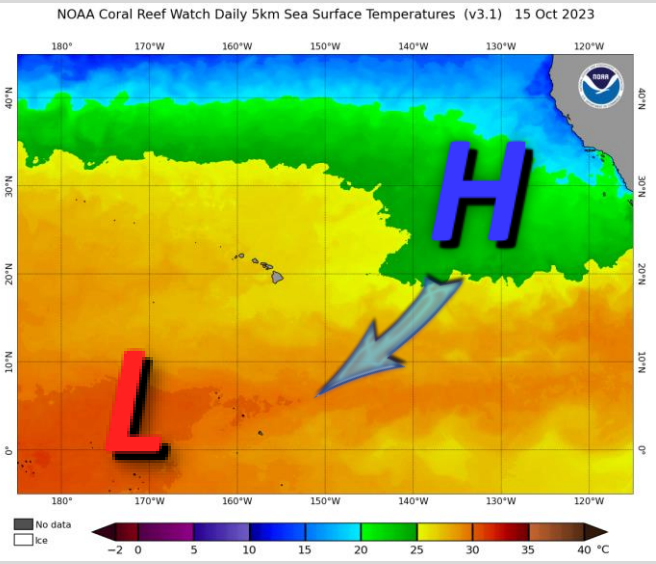

The Micronesia/Marshall Islands low in 2009-10 helped get convection and a negative Pacific North American (PNA) pattern going at times during winter. Why is this important? It looks like a similar set up in the northern Pacific Ocean in 2023, thunderstorms are likely to be common in this region in DJF due to anomalously strong surface convergence. When the polar or East Asian Jet (EAJ) moves just east of the thunderstorms in the CPAC and the associated strong temperature difference, the jet must get back into thermal balance and split (next slide). A high amplitude ridge of high pressure develops in the EPAC as a result and an upper-level trough and stormy weather forms over the Western U.S as a result.

2023-24 Winter Outlook

Madden-Julian Oscillation (MJO)

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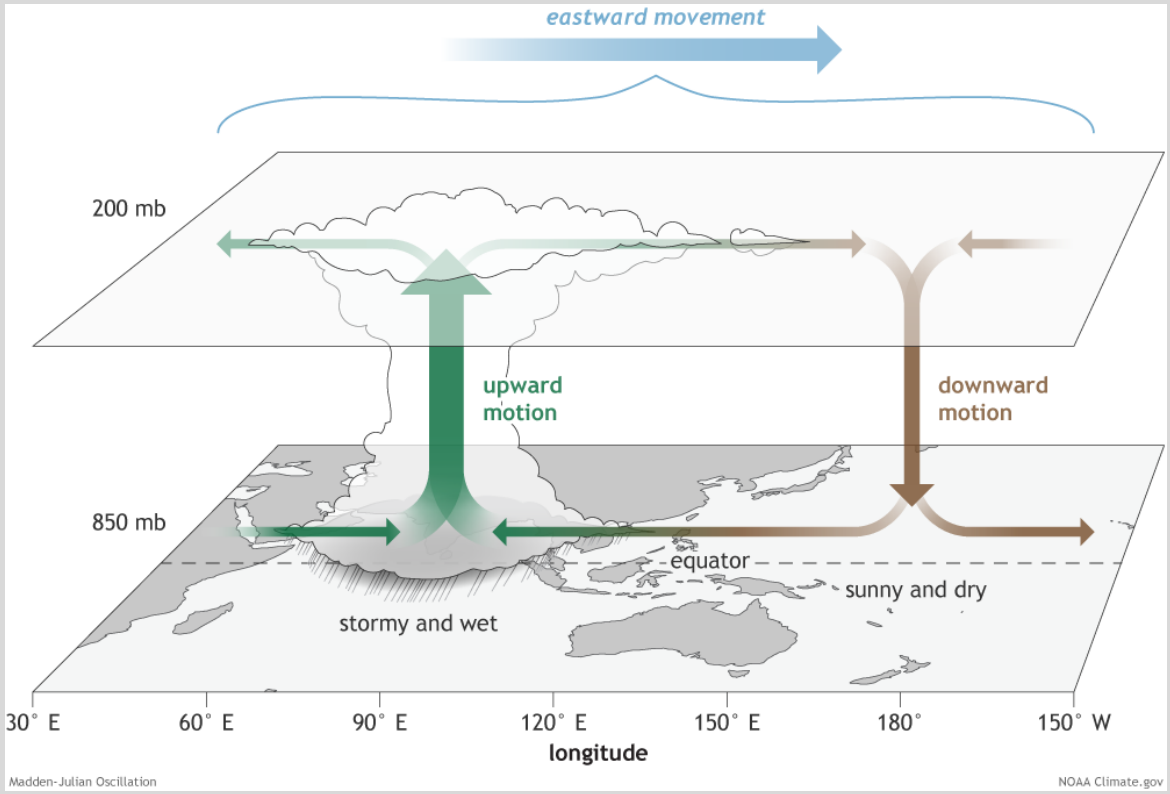

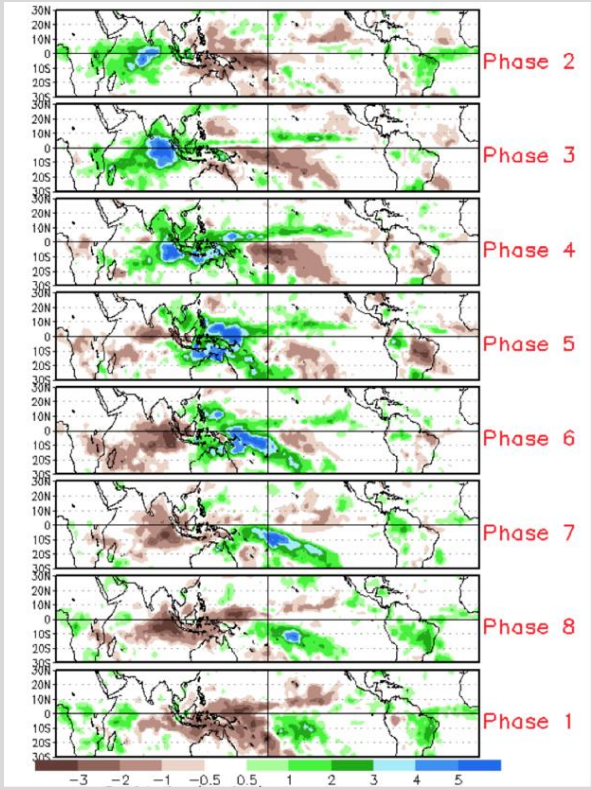

The Madden-Julian Oscillation (MJO) is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising air in the stormy region cause surface winds to blow toward the active area. During a developing La Niña, the trade winds are stronger than average, helping to bring cooler waters up to the surface. When La Niña comes to an end, the enhanced trade winds weaken, allowing warmer water to return to the eastern Pacific and either neutral conditions or an El Niño to develop. This warmer water allow thunderstorms related to the MJO to continue eastward into the EPAC, influencing the jet stream. Typically, El Niño results in above average precipitation in New Mexico during the cool season.

2023-24 Winter Outlook

SST Model Predictions from IRI

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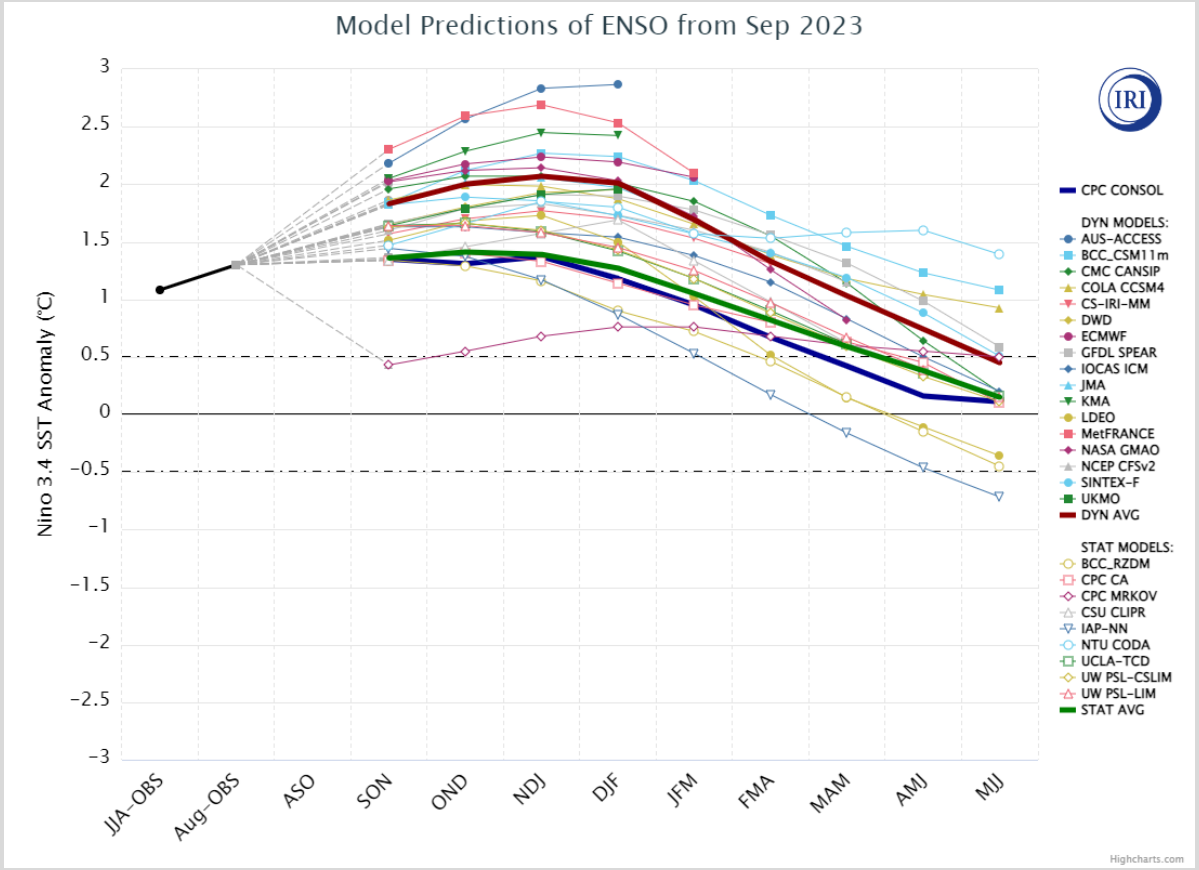

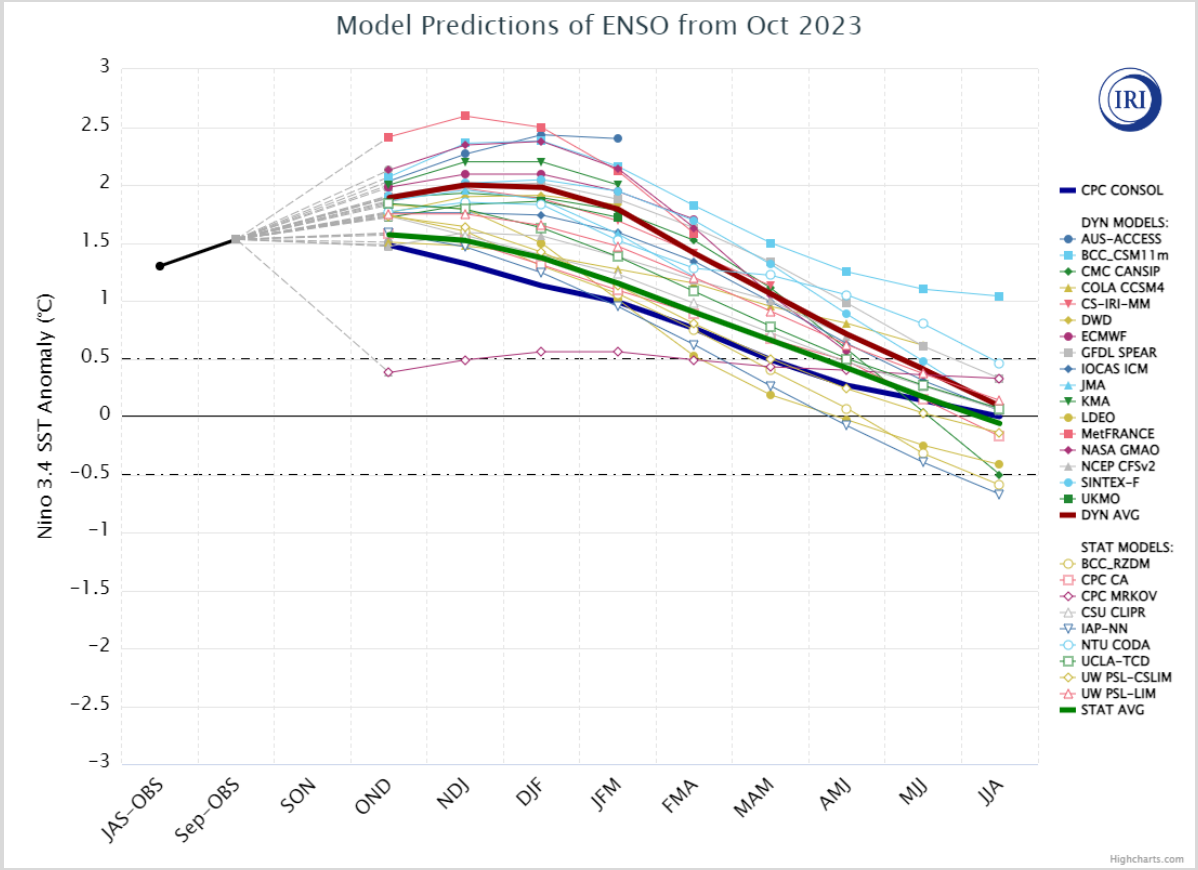

Model prediction of ENSO from September and October 2023. Dynamical model average for October, November and December is just under 2.0 C or a higher-end moderate El Niño.

2023-24 Winter Outlook

Climate Model Forecasts – Dec & Jan

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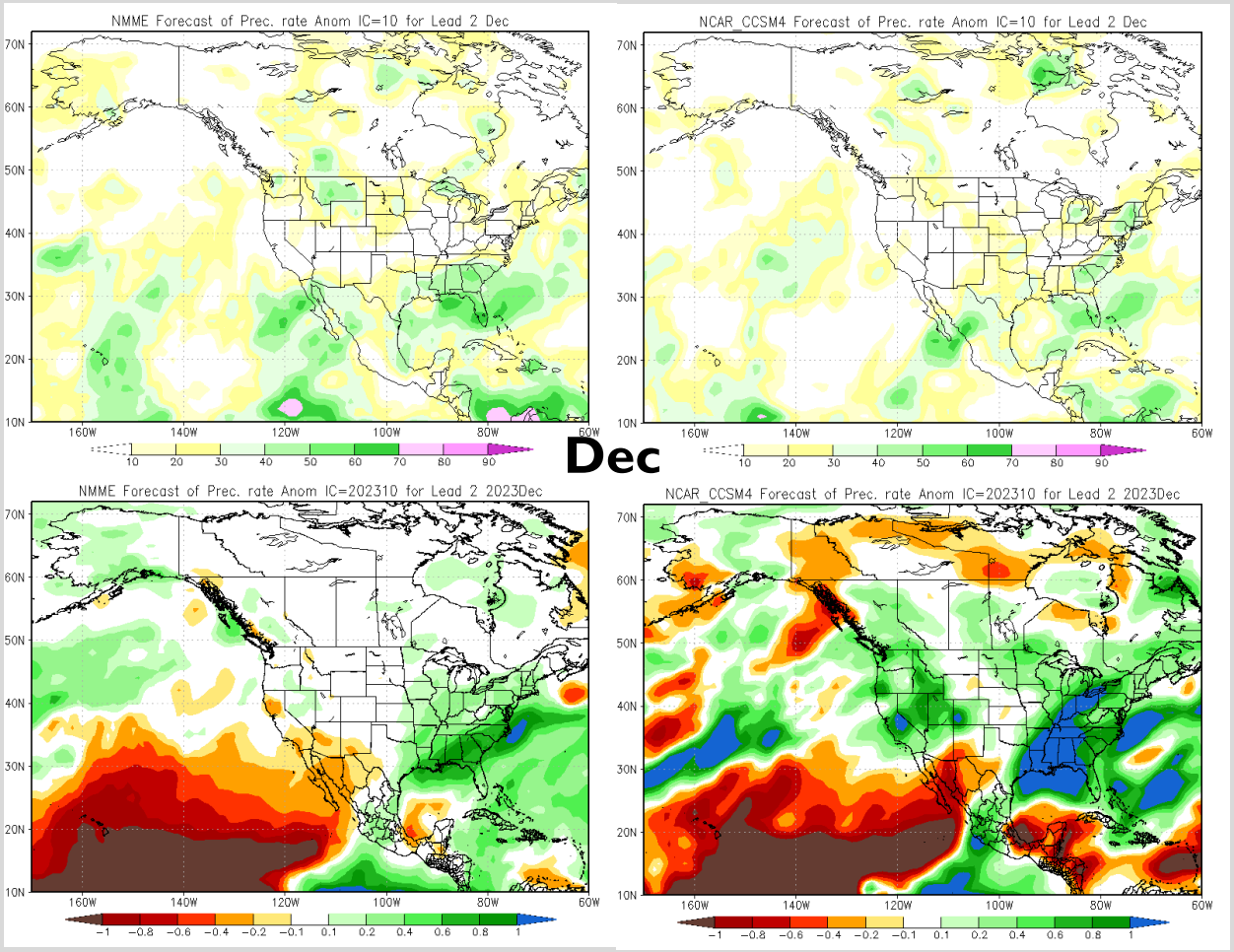
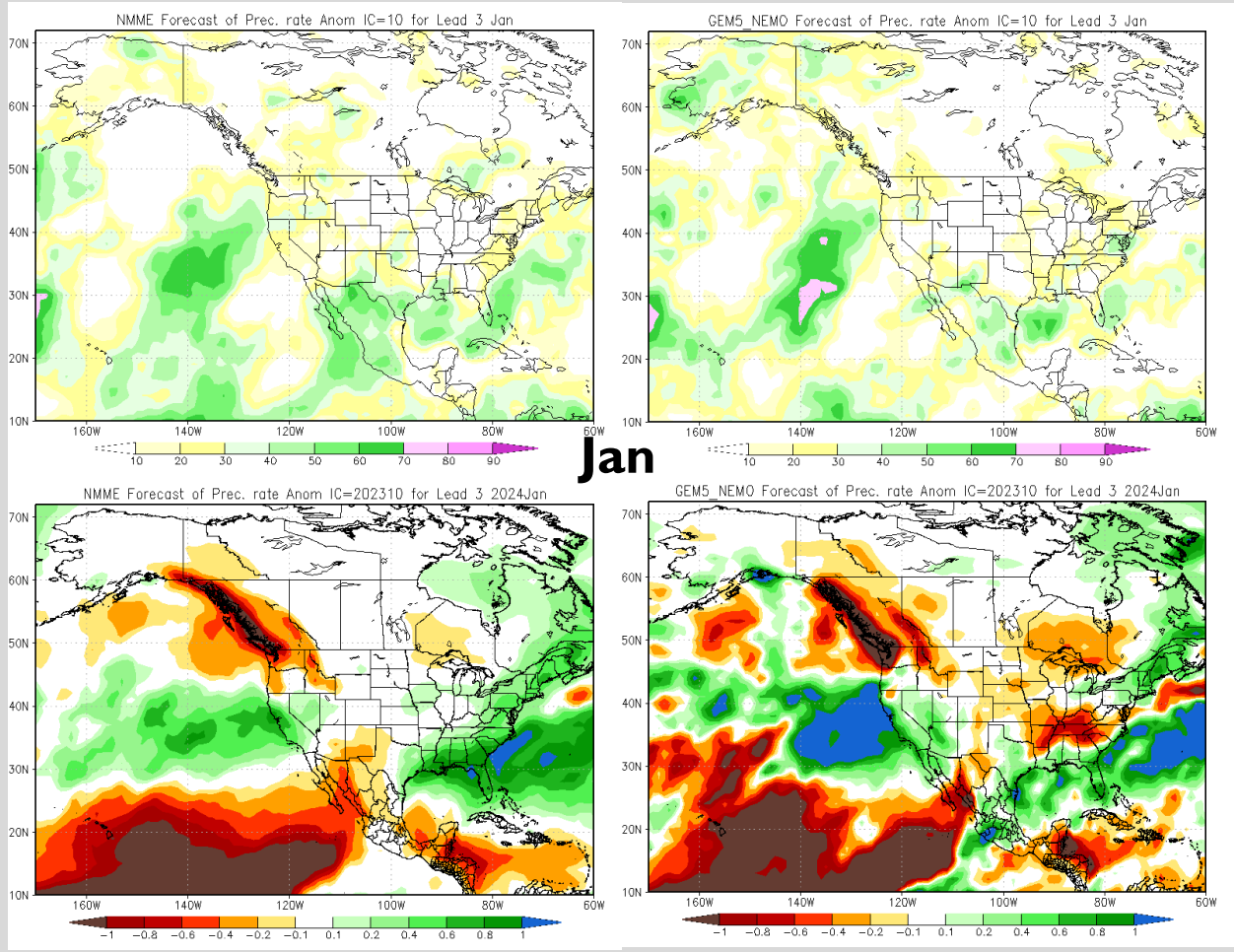


Dec



Jan

Model precipitation rate anomaly from the two climate models that have the highest forecast skill percentages (top row), the North American Multi-Model Ensemble (NMME) and the NCAR_CCS4 for December and January. Both models show fair to good forecast skill for NM during DJF and are forecasting near average precipitation.

2023-24 Winter Outlook

Climate Model Forecasts - Feb

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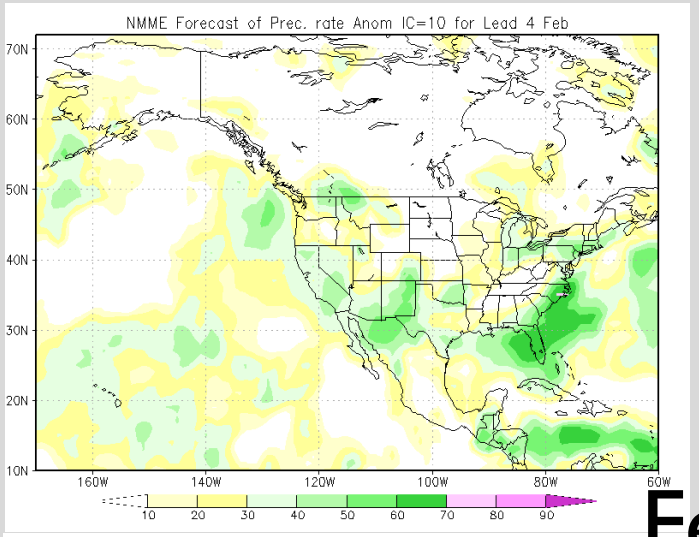
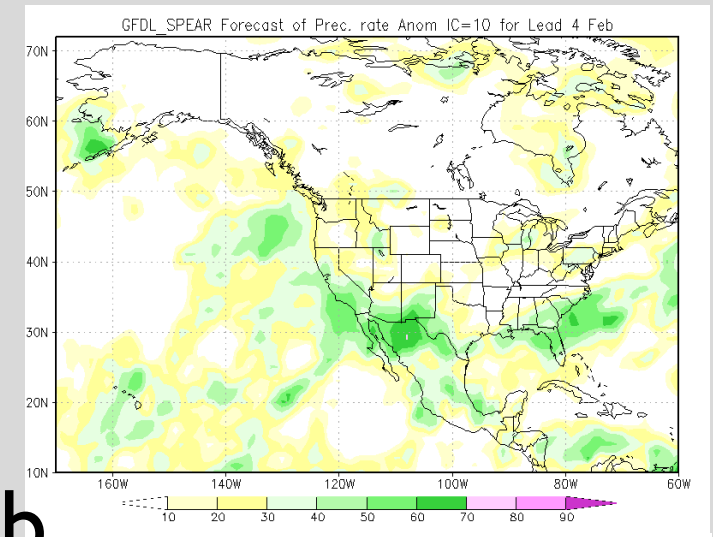
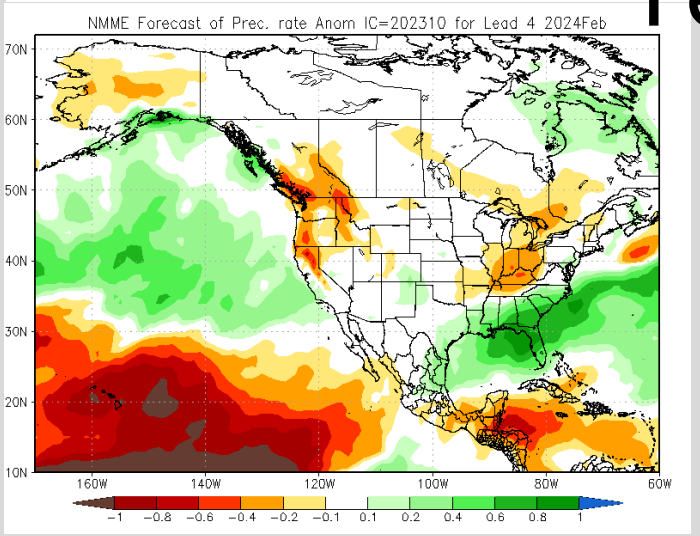
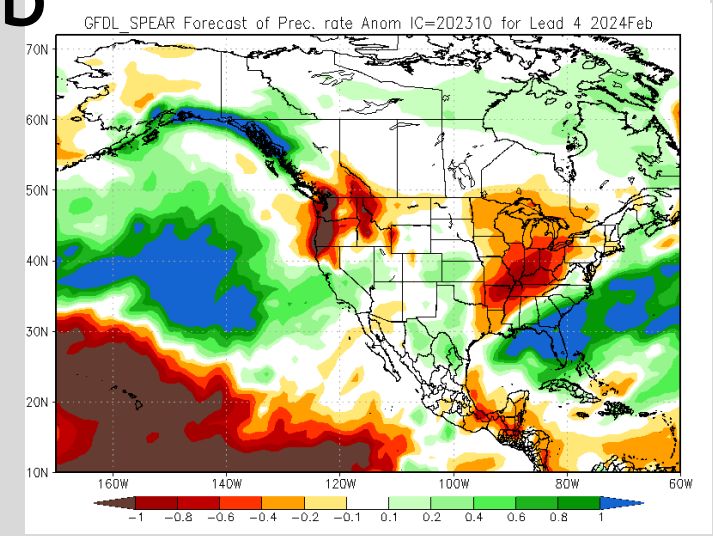




Feb





Model precipitation rate anomaly from the two climate models that have the highest forecast skill percentages (top row) for February, the North American Multi-Model Ensemble (NMME) and the GFDL_SPEAR. Both models show fair to good forecast skill for NM during February and are forecasting near to slightly above average precipitation.

2023-24 Winter Outlook

Climate Model Forecasts - Temperature

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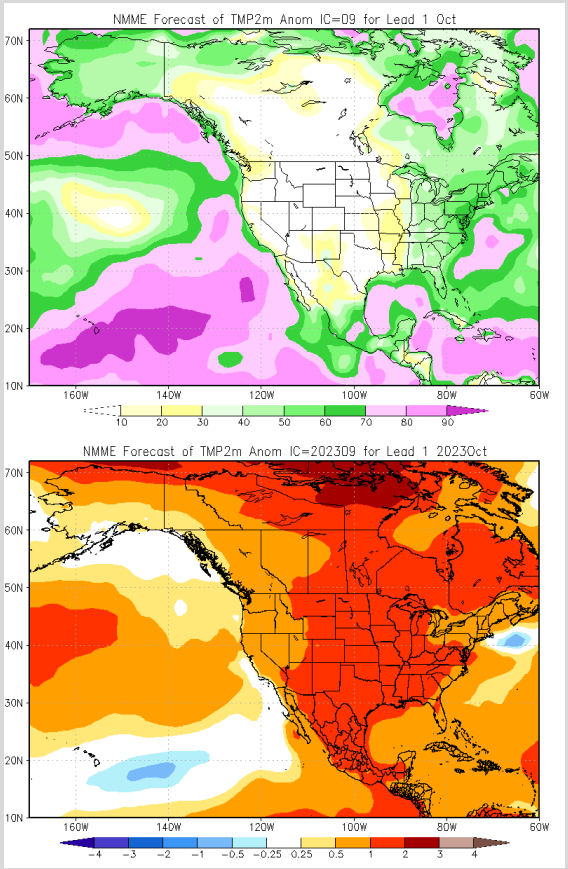

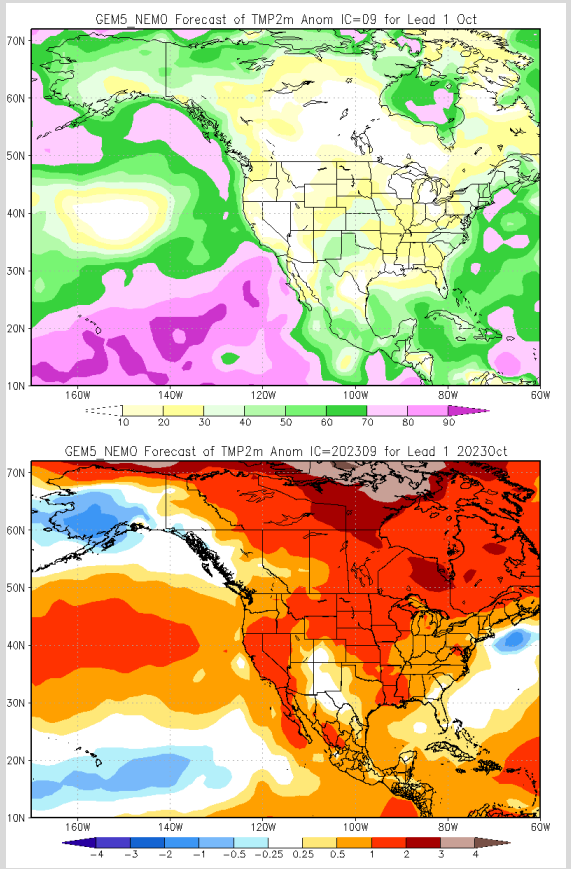

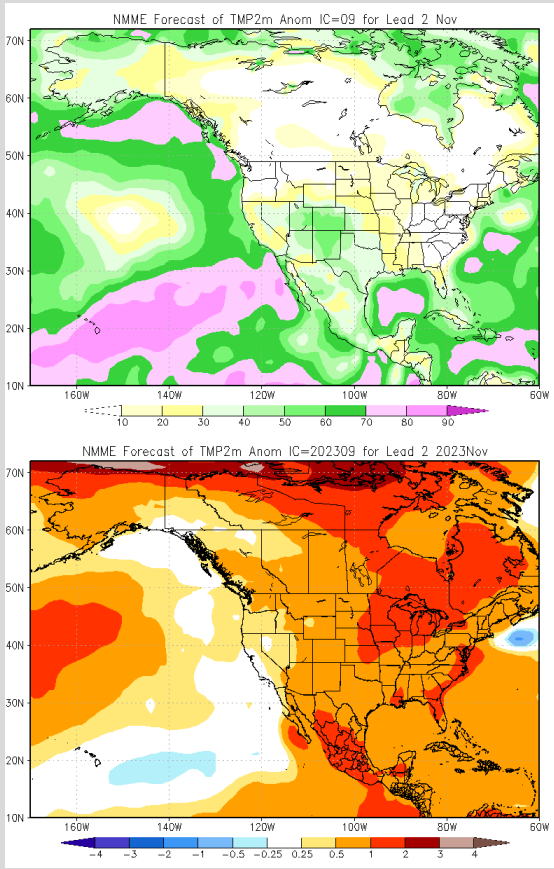

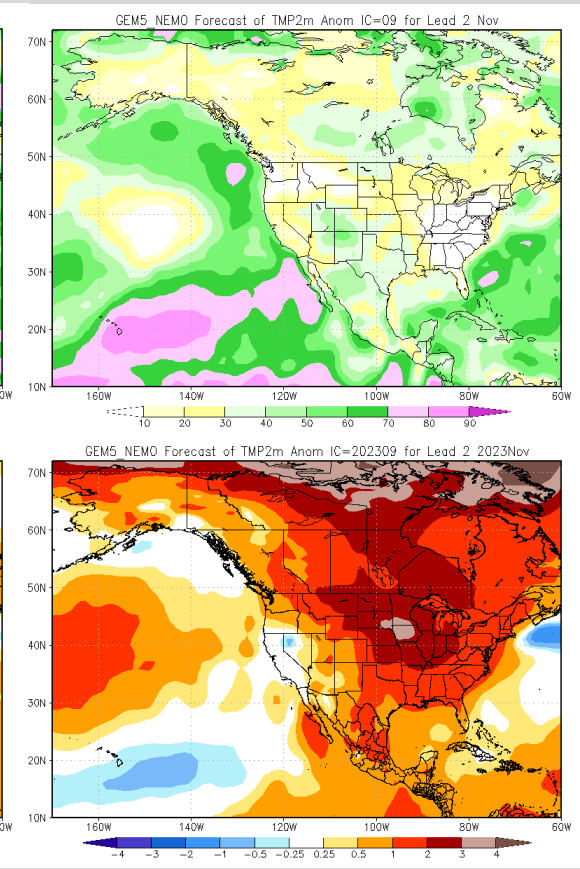

Temperature difference from average forecasts from the two climate models that have the highest temperature forecast skill (top row), the North American Multi-Model Ensemble (NMME) and GEM5_ NEMO model. Both model forecasts are predicting slightly above to above average temperatures in DJF.

2023-24 Winter Outlook

Climate Prediction Center (CPC)

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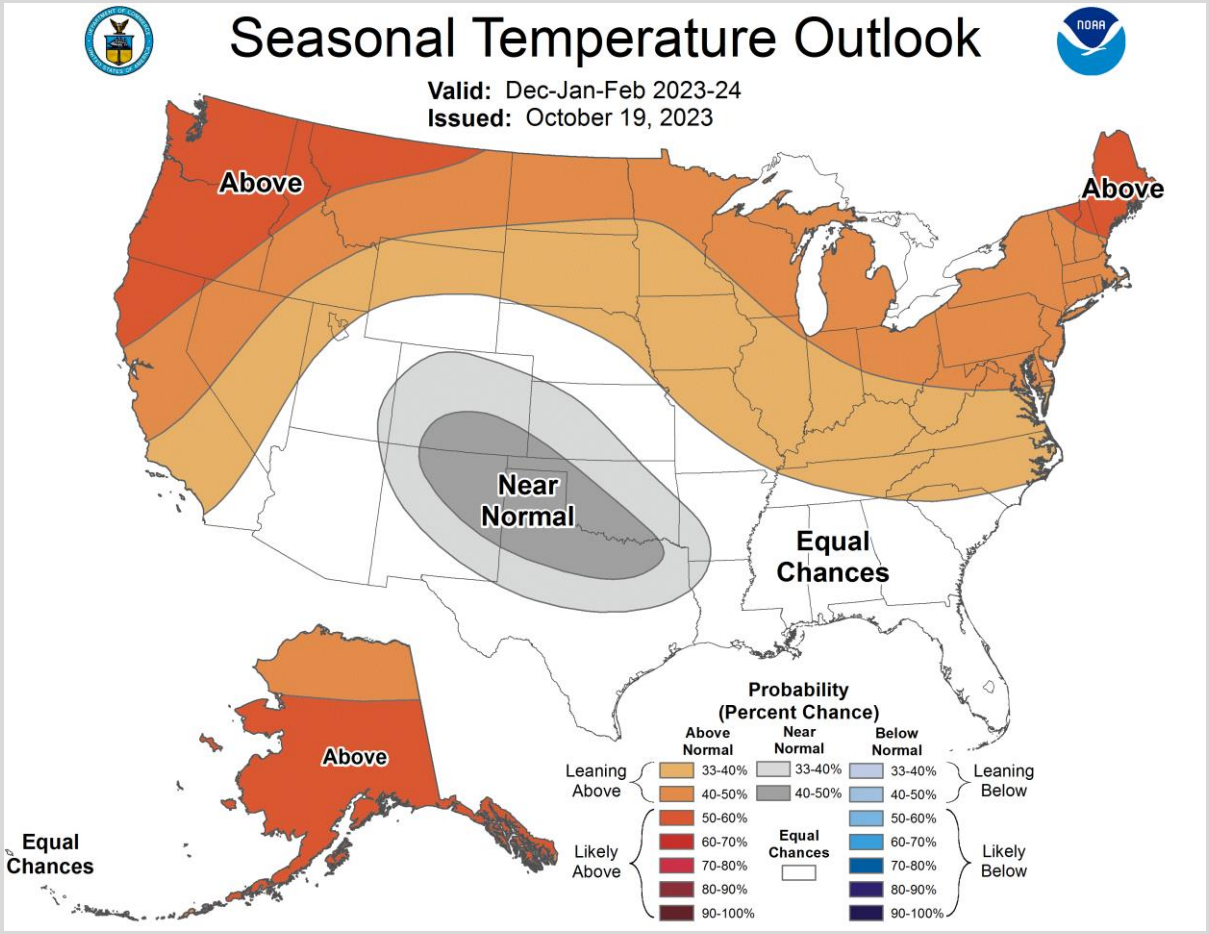

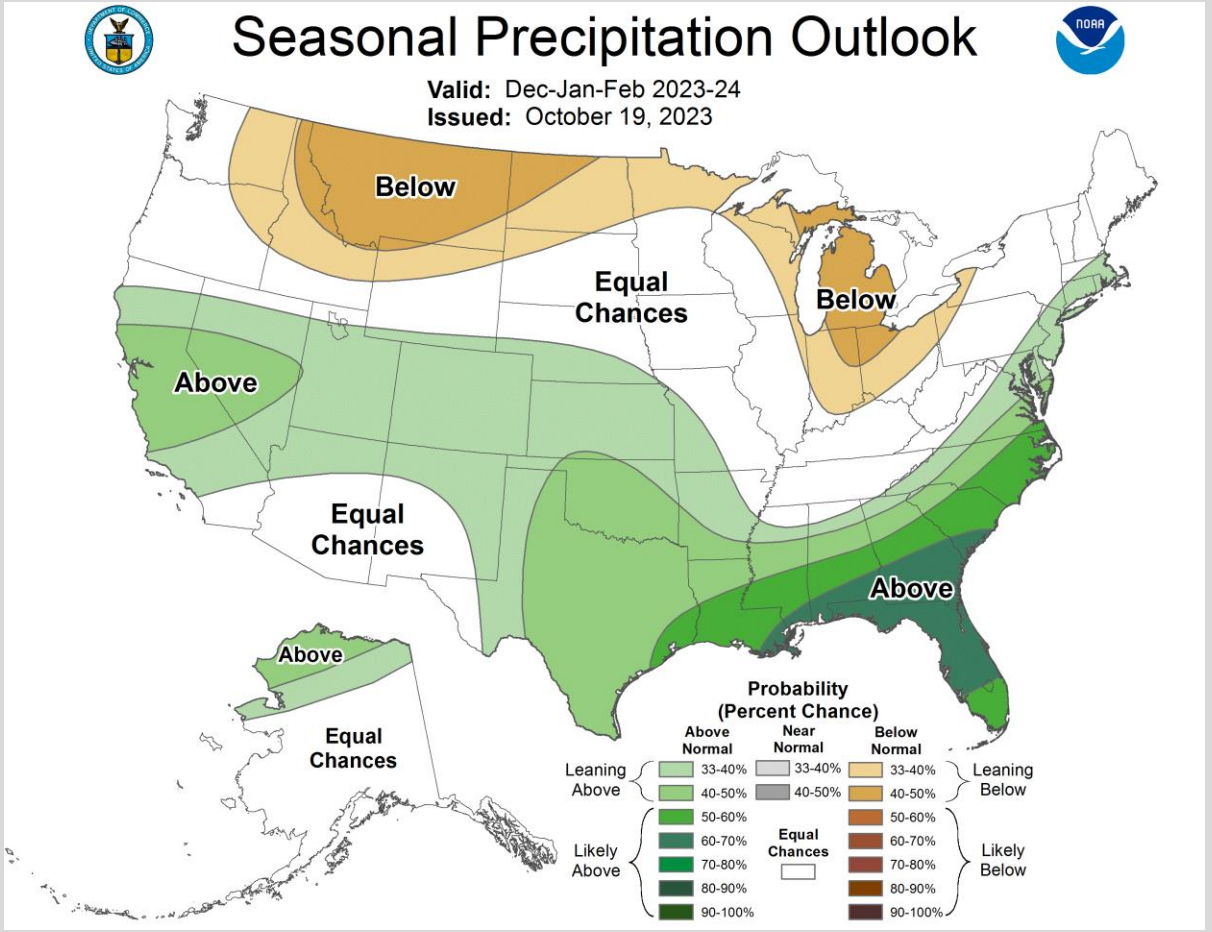

NWS's Climate Prediction Center's Official 2023-24 Seasonal Outlook for December, January and February showing probabilities leaning above average precipitation north of I-40 with equal chances of slightly above or slightly below average temperatures. This is the pattern that higher skilled climate models are showing.

2023-24 Winter Outlook

European Center for Medium Range Weather Forecasts (ECMWF)

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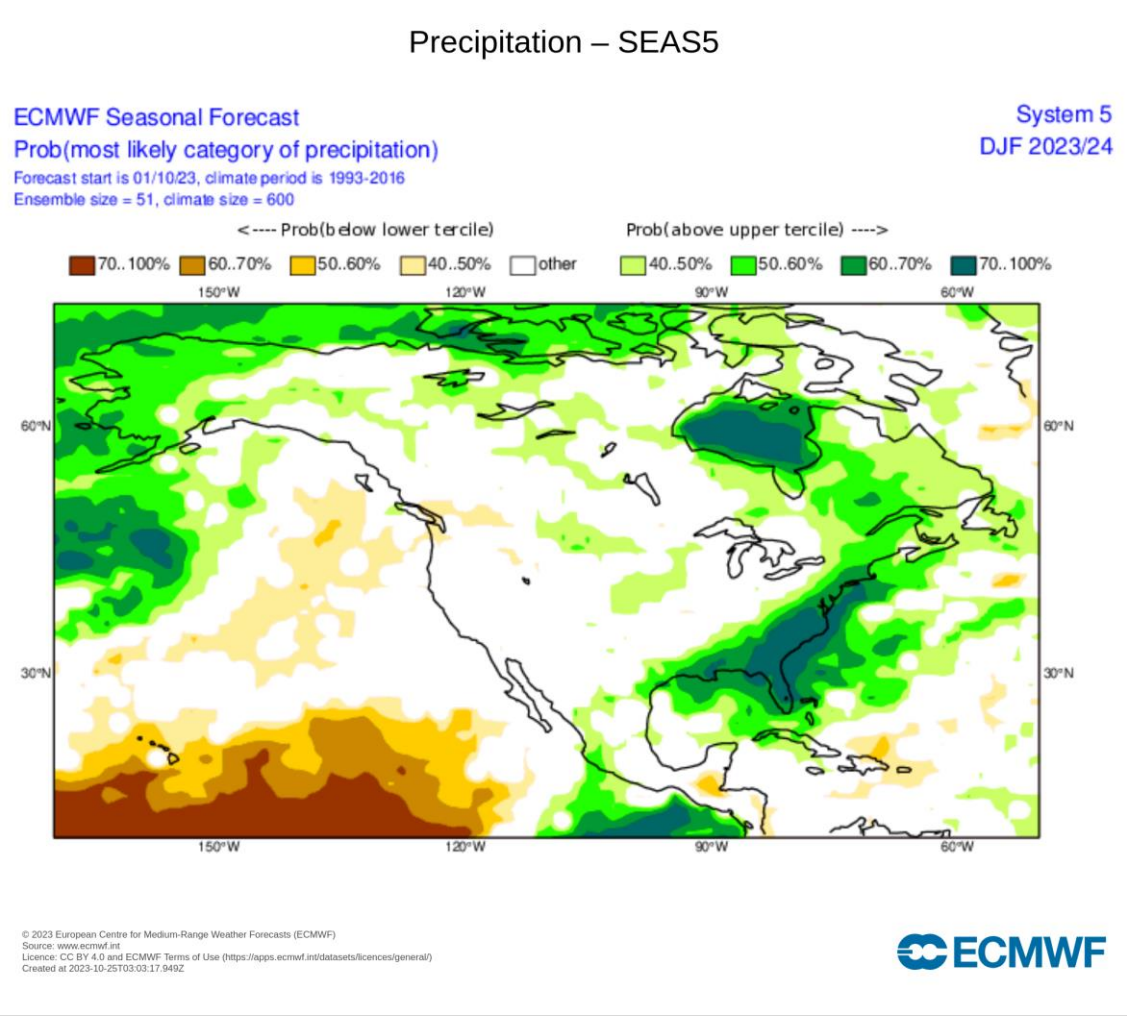

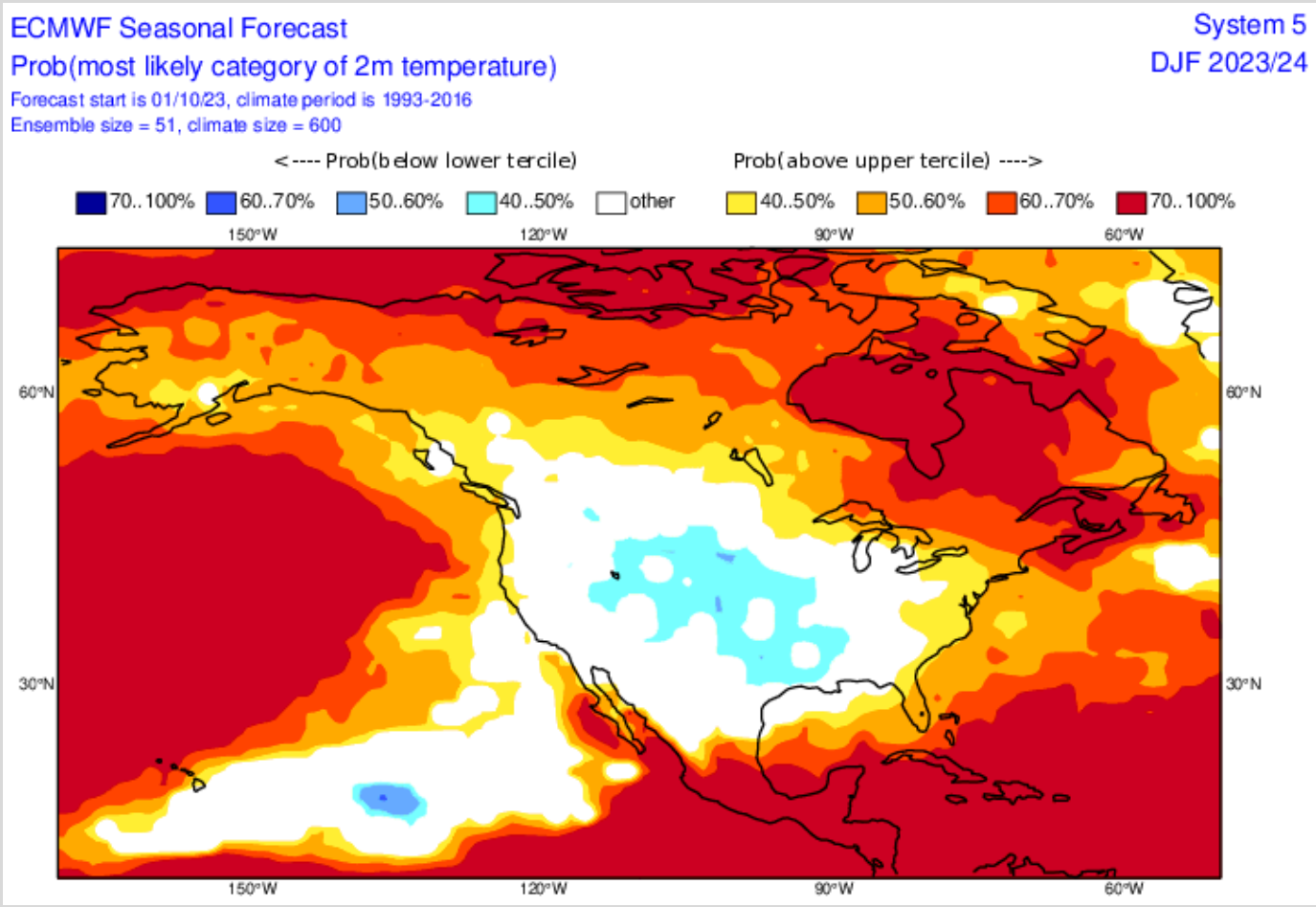

Seasonal precipitation and temperature difference from average forecast from the European Center for Medium Range Weather Forecasts (ECMWF) seasonal model forecasting near average winter (DJF) precipitation and slightly below average temperatures.

2023-24 Winter Outlook

ECMWF (ENS) - Precipiation

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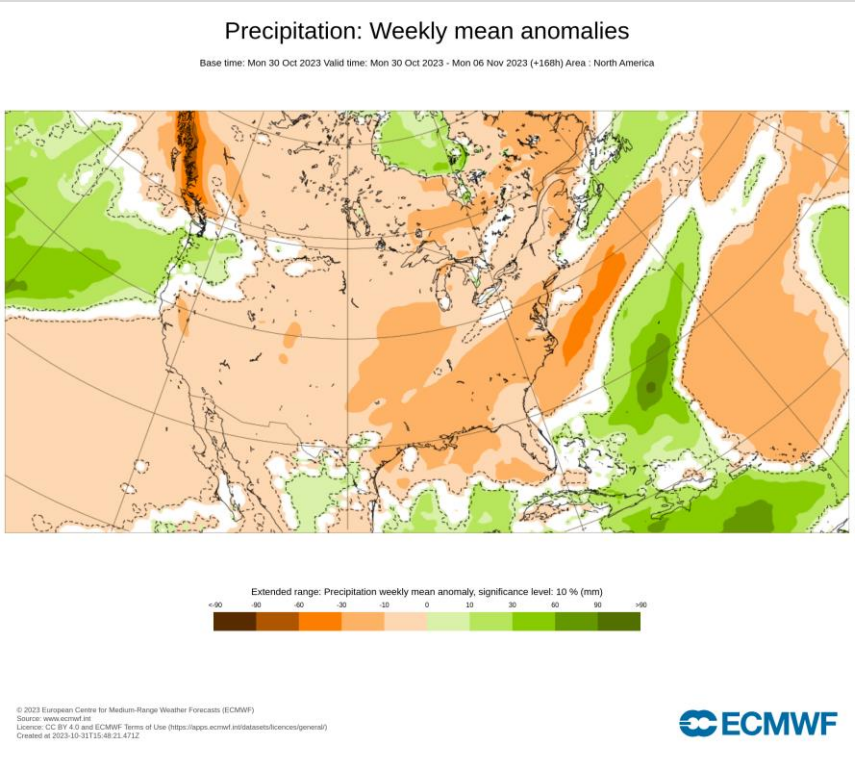

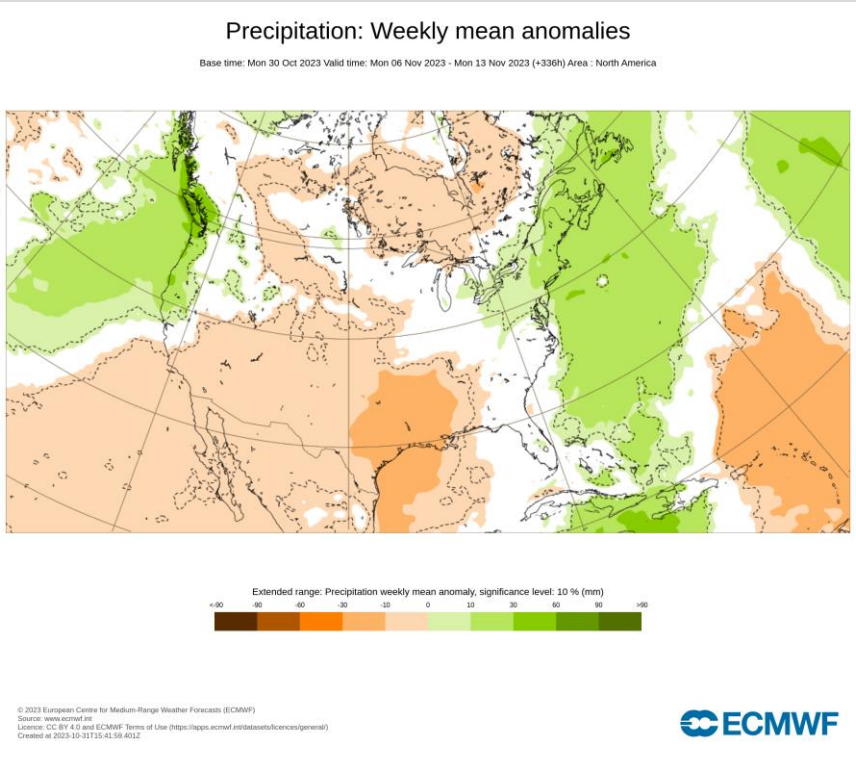

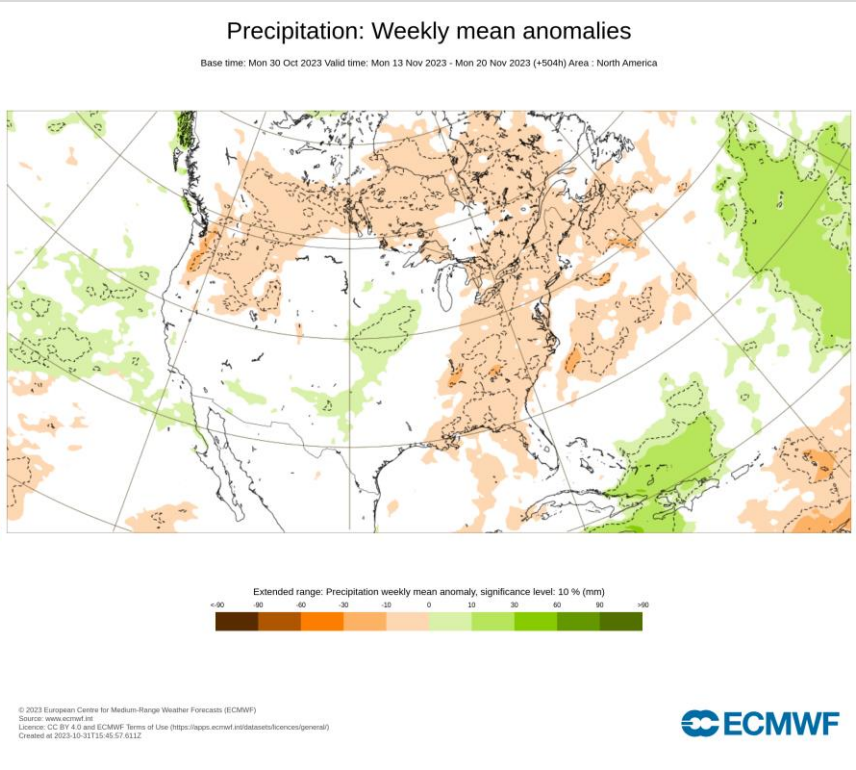

Weekly difference from average precipitation forecasts from the ECMWF (ENS) model. A dry first two weeks of November remains in the forecast. That changes around the middle of November with a transition toward average to slightly above average precipitation during the week of November 13 through early December.

2023-24 Winter Outlook

ECWMF (ENS) - Precipiation

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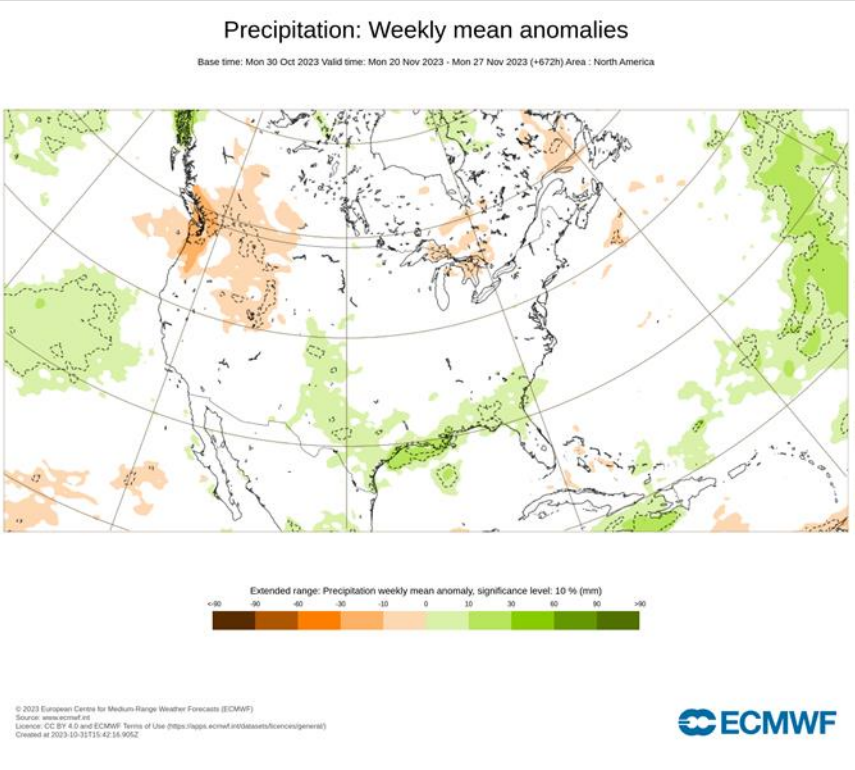

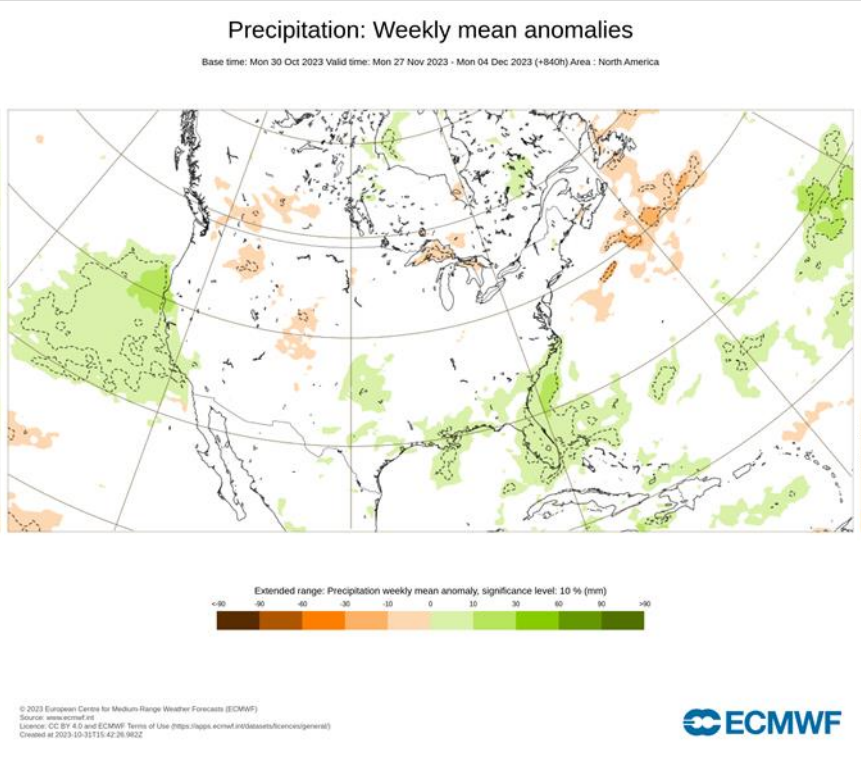

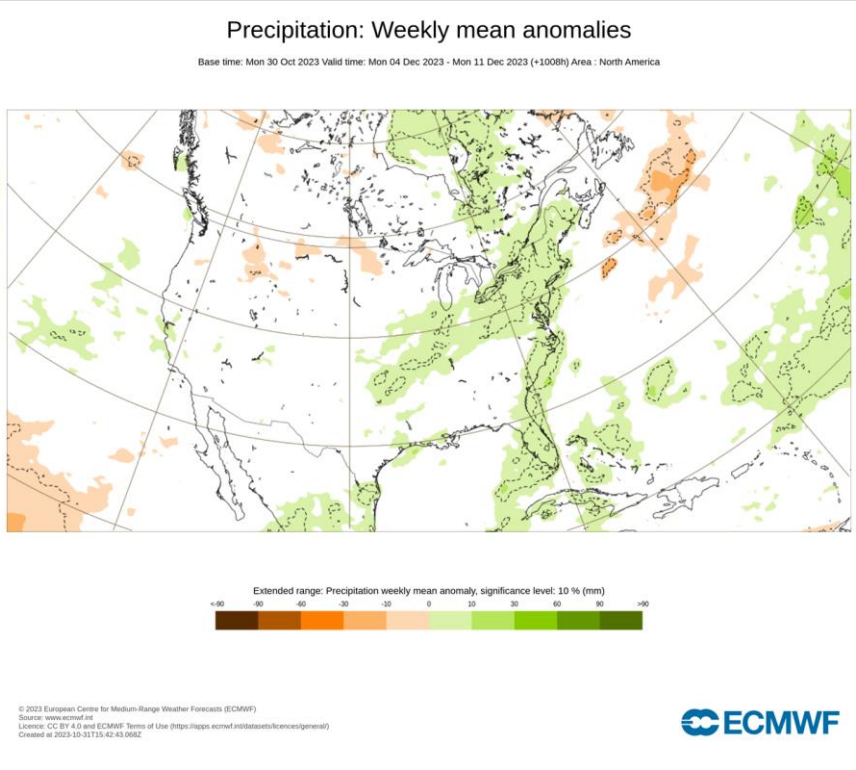

Weekly difference from average precipitation forecasts from the ECMWF for mid November through early December 2023. The ensemble model is forecasting near to slightly above average precipitation for NM.

2023-24 Winter Outlook

ECWMF (ENS) - Temperature

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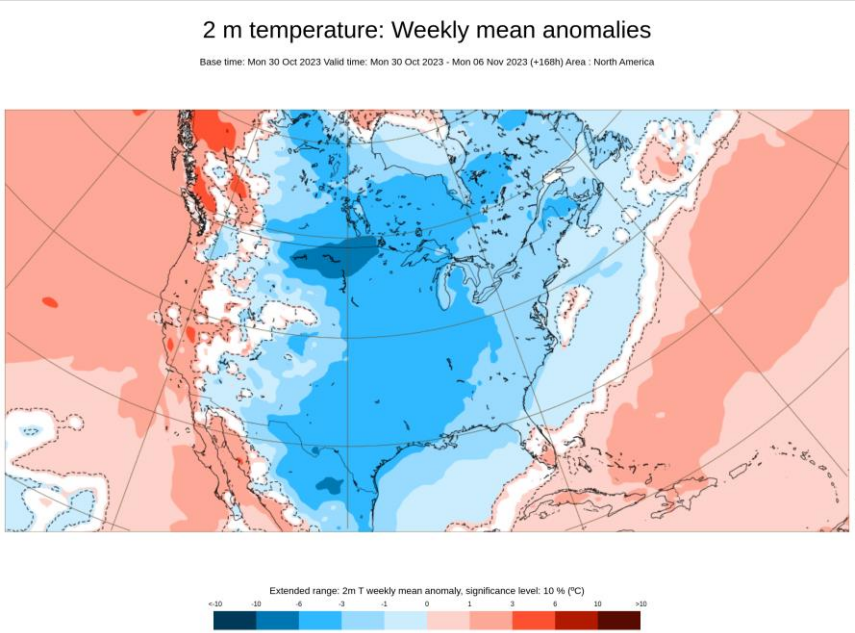

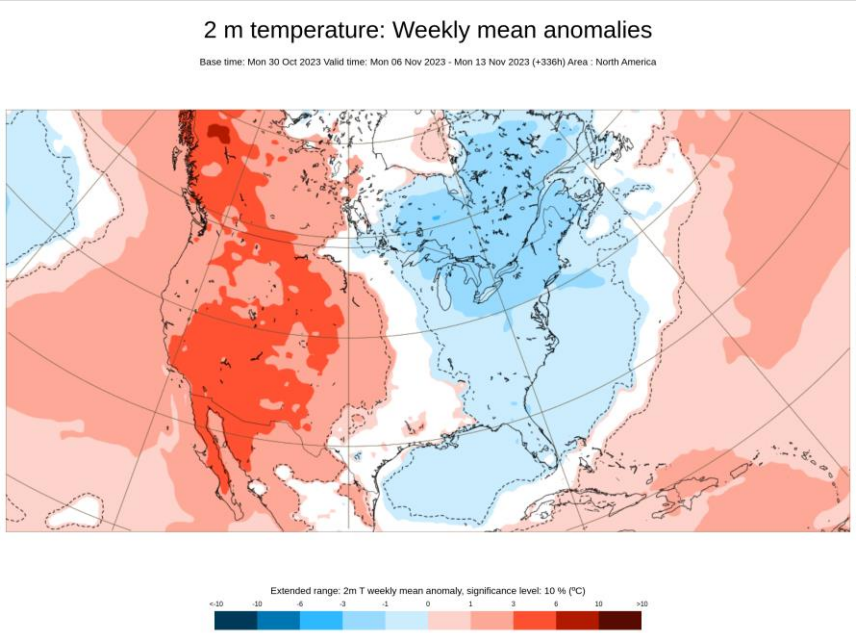

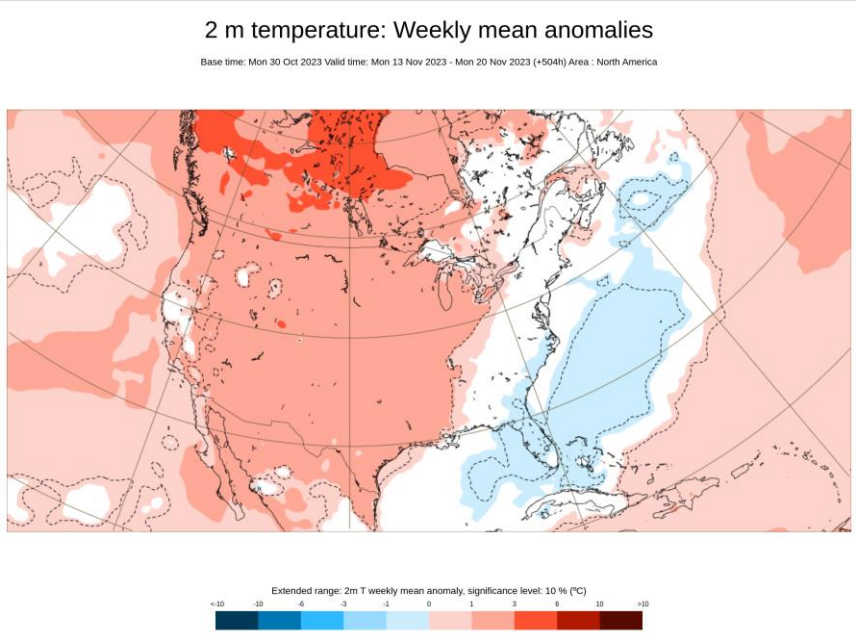

Weekly difference from average temperature forecasts from the European Center for Medium Range Weather Forecasts (ECMWF) for much of November. ECMWF's extended ensemble model keeps the Southwest U.S. warmer to much warmer than average through mid November.

2023-24 Winter Outlook

ECMWF (ENS) - Temperature

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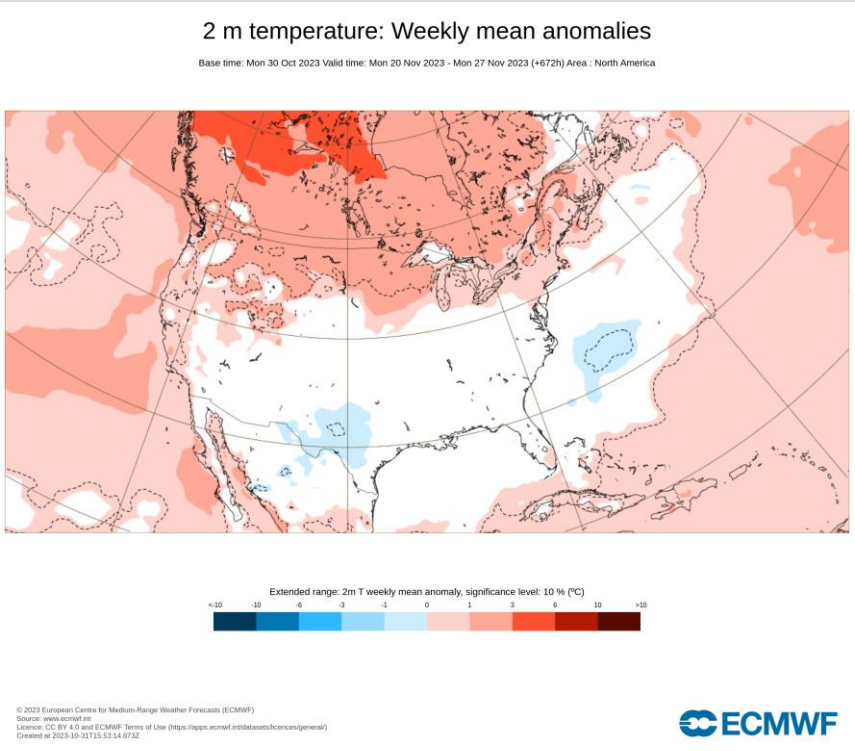

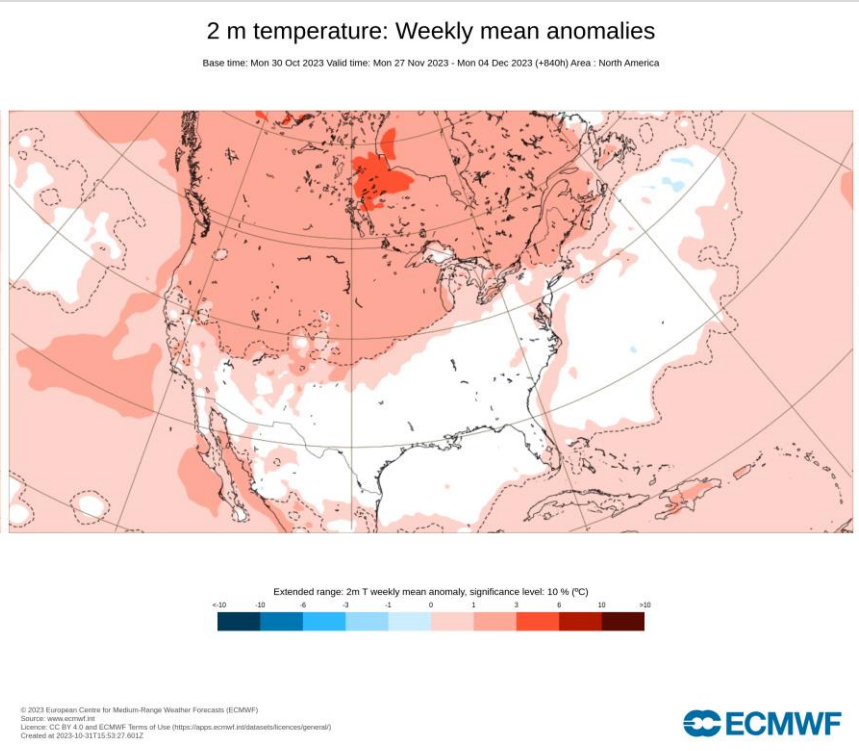

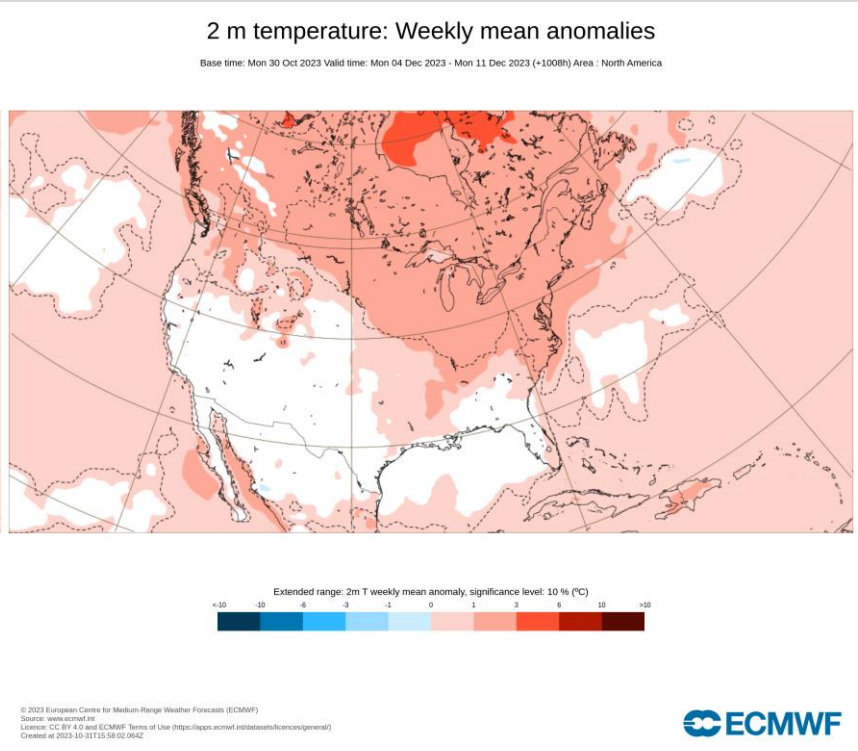

Weekly difference from average temperature forecasts from the European Center for Medium Range Weather Forecasts (ECMWF) for late November through early December 2023. ECMWF's extended ensemble model keeps the Southwest U.S. near average during this time.

2023-24 Winter Outlook

What is Average?

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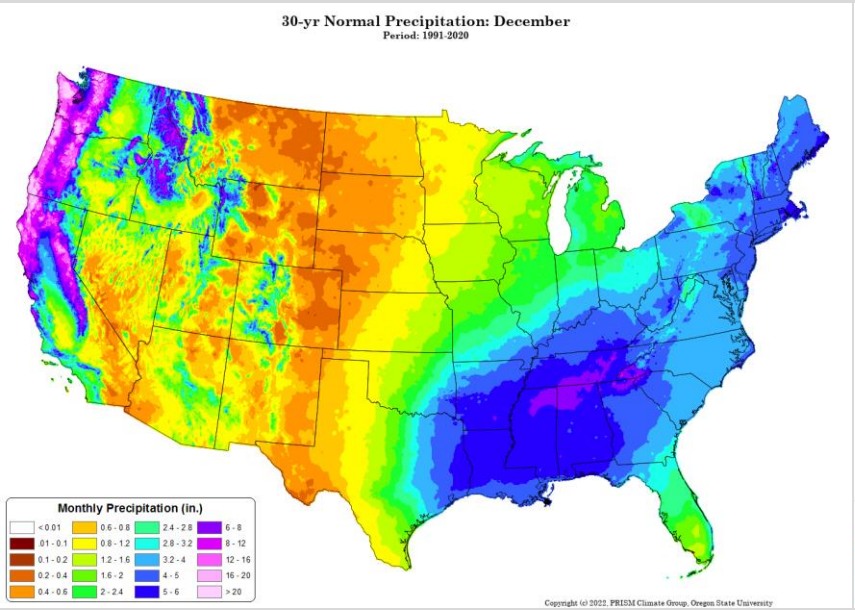

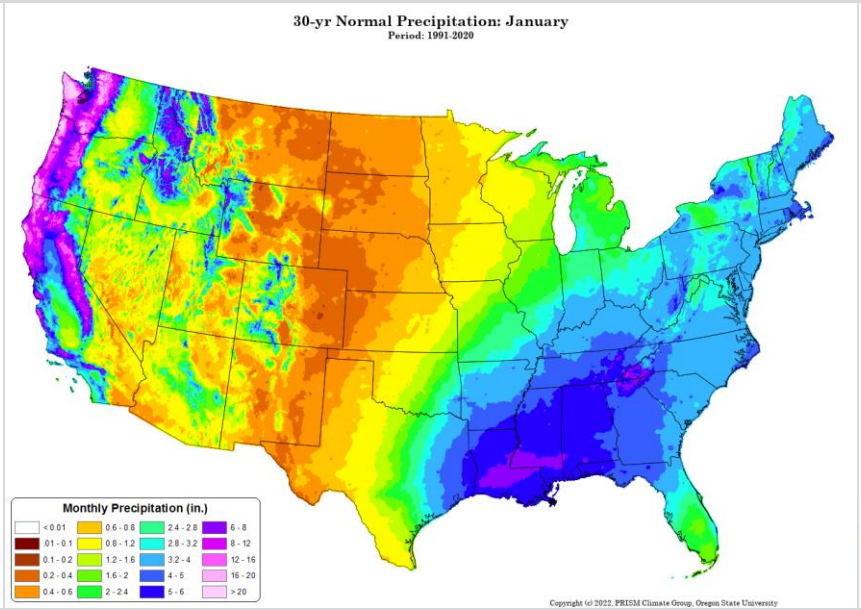

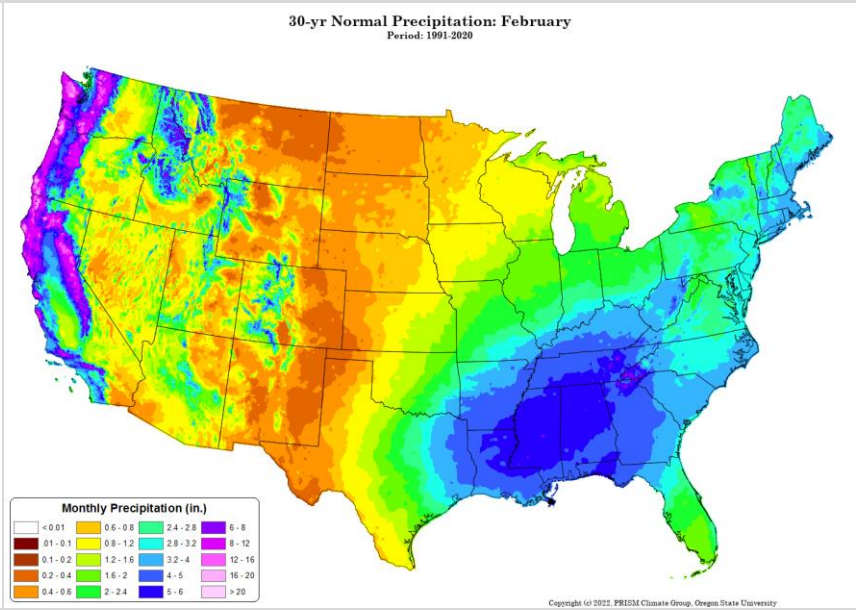

What is average or normal precipitation during winter? These charts show normal or average precipitation for each month during meteorological winter.

2023-24 Winter Outlook

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December: Forecast confidence is moderate to high for slightly above to above average precipitation central areas and above average for the northwest third. Forecast confidence is also high for near to slightly below average temperatures.

January: Forecast confidence is high for near to slightly above average precipitation and slightly below average temperatures.

February: Forecast confidence is high for slightly above to above average precipitation and near average temperatures.

2023-24 Winter Outlook

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- Outlook provided by National Weather Service Forecast Office Albuquerque, NM.
- For further information contact Andrew Church: andrew.church@noaa.gov (505) 244-9150